TRANSACTIONS

OF THE

NEW ENGLAND

WATER WORKS ASSOCIATION,

DURING THE YEAR

1885.

NEWTON:
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1886.

NEW ENGLAND WATER WORKS ASSOCIATION.

OFFICERS 1885-6.

President,

ROBERT C. P. COGGESHALL, New Bedford, Mass.

Vice-Presidents,

WM B. SHERMAN, Providence, R. I.
WM. R. BILLINGS, Taunton, Mass.
SHERMAN E. GRANNIS, New Haven, Conn.
BENJAMIN S. BABCOCK, Nashua, N. H.
F. H. PARKER, Burlington, Vt.

Secretary.

ALBERT S. GLOVER, Newton, Mass.

Treasurer,

EDWIN DARLING, Pawtucket, R. I.

Executive Committee,

The above named officers with

GEORGE A. ELLIS, Springfield, Mass.
WALTER H. RICHARDS, New London, Conn.
FRANK E. HALL, Quincy, Mass.

Finance Committee,

GEORGE E. BATCHELDER, Worcester, Mass.
NATHANIEL I. JORDAN, Auburn, Me.
WALTER H. HARDING, Cambridge, Mass.

The Fifth Annual Meeting of the Association will be holden at New Bedford, Mass., on Wednesday, Thursday and Friday, June 16, 17 and 18, 1886; the following topics have been assigned for consideration:

1st. The Discharge of Mains as determined by the Pressure Gauge.

Paper by Geo. A. Ellis, C. E., City Engineer and Water Registrar, Springfield, Mass.

2d. Information Relative to the Best Type of Water Power Pumping Machinery.

Paper by Col. J. T. Fanning, C. E., Manchester. N. H.

3d. Proportions and General Treatment of Artificial Reservoirs.

Paper by Alphonse Fteley, C. E., Executive Engineer New Croton Aqueduct, N. Y. City.

4th. Rainfall; the Amount Available for Water Supply.

Paper by Desmond Fitzgerald, C. E., Supt. Western Division, Boston Water Works.

5th. Water Waste.

Paper by Dexter Brackett, C. E., Asst. City Engineer, Boston, Mass.

NEW ENGLAND WATER WORKS ASSOCIATION.

PREAMBLE, CONSTITUTION AND BY-LAWS.

PREAMBLE.

We, the undersigned, desirous of forming an Association for the exchange of information pertaining to the management of "Water Works," for the mutual benefit of consumers and "Water Companies," and for the purpose of securing economy and uniformity in the operation of Water Works, do hereby associate ourselves and adopt the following

CONSTITUTION AND BY-LAWS.

ARTICLE I.

NAME AND OBJECTS.

SECTION 1. The name of the Association shall be "The New England Water Works Association."

SECT. 2. The object of the Association shall be the promotion and advancement of knowledge, scientific and practical, in all matters relating to the construction and management of "Water Works" and the destribution and consumption of water, the establishment and maintenance of a spirit of "fraternity" between the members of the Association, by social intercourse and by friendly interchange of information and ideas on the before-mentioned subjects.

ARTICLE II.

SECT 1. The members of this Association shall consist of two classes,—Active members and Associate members.

SECT. 2. To be eligible as an Active member, a person must be a Superintendent, Registrar, Secretary, Treasurer or Engineer of a Water company.

SECT. 3. Active members shall pay an initiation fee of five dollars, and shall pay the sum of two dollars annually thereafter, which sum shall be paid in advance.

SECT. 4. No member whose annual payment shall be in arrears one year shall be entitled to vote or participate in the deliberations of the Association.

SECT. 5. Any member may retire from membership by giving written notice of his desire to the Secretary and by the payment of all annual dues to that date, but he shall remain a member and be liable to the payment of annual dues till such payments are made.

SECT. 6. A member may be expelled from the Association after due notice to him by a report and motion to that effect made by the executive committee at a general meeting of the Association. The vote shall be by ballot and shall require two-thirds of the votes cast for its adoption.

ARTICLE III.

ASSOCIATE MEMBERS.

SECT. 1. Persons or firms engaged in furnishing materials for the construction and maintenance of Water Works desiring to join the Association may be admitted as members by the usual form on the payment of ten dollars; their annual dues shall be five dollars, and they shall be entitled to one representative at each meeting, but shall not be entitled to vote or take part in any discussion unless permission be given by the meeting.

ARTICLE IV.

SECT. 1. All candidates for membership shall be proposed by a member of the executive committee, and notice thereof shall be given by the Secretary to the Association for its action. The election of an applicant for membership shall be by ballot, and each person shall receive two-thirds of the number of ballots cast to be elected.

SECT. 2. If any application for membership, on being balloted for, be rejected, no notice shall be taken of the application or record of the same be made in the minutes, and the admission fee shall be returned.

SECT. 3. New members shall be formally introduced to the Association by the presiding officer, after being elected; they shall subscribe their names to the Constitution of the Association, in a roll-book of the same, and they shall each at the same time receive a copy of the Constitution and By-Laws of the Association.

ARTICLE V.

OFFICERS.

SECT. 1. The officers shall consist of a President, five Vice Presidents, Secretary and Treasurer, to be elected annually by ballot.

SECT. 2. The officers of the Association, with three other members, who shall be elected for that purpose, shall constitute the Executive Committee.

SECT. 3. A Finance Committee, consisting of three members of the Association, shall be chosen.

All officers shall serve for one year, or until their successors are elected.

ARTICLE VI.

DUTIES.

SECT. 1. The President shall preside at all meetings, or in case of his absence the senior Vice President present shall preside.

SECT. 2. The affairs of the Association shall be managed by the Executive Committee, subject to control of the Association by its action in general meeting. All questions in Executive Committee shall be decided by majority vote, and five members shall be a quorum.

The Executive Committee shall have control of the property and management of the affairs of the Association; shall provide suitable rooms for all annual and other meetings, and shall have power to expend the funds of the Association: *provided*, that no indebtedness shall be incurred in excess of the funds in the hands of the Treasurer. All papers read at meetings of the Association must relate to matters connected with the objects of the Association, and must be approved by the Executive Committee before being read, and they shall also suggest topics for discussion.

SECT. 3. The Secretary shall keep the records of all meetings, conduct all correspondence, receipt for all fees and dues, and pay to the Treasurer all money received, taking his receipt therefor. In addition to these duties he shall read minutes and also papers and communications, if the authors desire it, and discharge such other duties as may be required by the Constitution and By-Laws appertaining to his department. He shall have such compensation for his services as the Executive Committee may determine.

SECT. 4. It shall be the duty of the Treasurer to receive from the Secretary all moneys for the Association, to keep correct account of all receipts and expenditures, and to pay all demands against the Association when approved by the President. At the annual meeting he shall exhibit a statement of his accounts and shall give such bonds as may be required by the Executive Committee.

SECT. 5. The Finance Committee shall meet on the day of the Annual Meeting of the Association, at least one hour before the

opening of the meeting, to receive from the Treasurer a statement of his account and to audit the same. They shall hold such other meetings as the interest of the Association may require.

SECT. 6. The officers of the Association shall assume office immediately after the close of the meeting at which they have been elected. They shall hold meetings at the call of the President, or, in the absence of the President, at the call of the senior Vice President.

ARTICLE VII.

SECT. 1. The Annual Meeting of the Association shall be held on the third Thursday in June, in each year, at 10 o'clock, A. M., at such place as shall be determined by the Association at the previous annual meeting. Other general meetings of the Association may be held at such times and places as shall be directed at the previous meeting.

SECT. 2. At any Regular meeting of the Association, ten members shall be a quorum for the transaction of business.

SECT. 3. The Secretary shall send a notice to all members of the Association at least fourteen days before each general meeting.

SECT. 4. Questions shall be decided by any convenient form of voting, the presiding officer to have the casting vote when necessary. Questions of special nature shall be decided by ballot, if demanded.

ARTICLE VIII.

SECT. 1. Any member of a Water Board or Board of Water Commissioners or Board of Trustees of any Water Works is cordially invited to be present at any meeting of the Association as Honorary Member. Any member, with the concurrence of the presiding officer, may admit a friend at each meeting of the Association, but such person shall not take part in any discussion unless permission to do so be given by the meeting.

SECT. 2. All papers, drawings or models submitted to the meetings of the Association, shall be and remain the property of the authors.

SECT. 3. All propositions for adding to or altering any of the provisions of the foregoing Constitution, shall be submitted to the Executive Committee, who may bring it before the next meeting of the Association, and shall do so on the written request of any five members of the Association; and if two-thirds of the members present shall vote in favor of such alteration or amendment, it shall be adopted.

ORDER OF BUSINESS.

At the Annual Meeting of the Association, the order of business shall be,—

First. The reading of the minutes of the last meeting.
Second. The reading of applications, notices, and reports for new membership.
Third. The election and introduction of new members.
Fourth. The address of the President.
Fifth. Report of the Executive Committee on the management of the Association for the previous year.
Sixth. The report of the Treasurer.
Seventh. The report of the Finance Committee.
Eighth. The report of Special Committees.
Ninth. The Election of Officers.
Tenth. The reading of Papers of which notice has been given and Discussion upon the same.
Eleventh. General Business.

At other General Meetings of the Association the Order of Business shall be the same, except as to the 5th, 6th, 7th, and 9th clauses.

PROCEEDINGS

OF THE

FOURTH ANNUAL CONVENTION.

SPRINGFIELD, Mass., June 18, 1885.

The Fourth Annual Convention of the New England Water Works Association was called to order in the upper dining hall of the Massasoit House at 10 o'clock A. M., this day, President George A. Ellis, of Springfield, in the chair. After explanation by the President, to the effect that a large number of members were expected on trains arriving between 11 and 12 o'clock, on motion of Mr. Hall, of Quincy, a recess was taken until 11.45.

Upon reassembling, the President presented to the Association Mr. Sanderson, Chairman of the Springfield Water Board, who spoke as follows:—

Mr. Chairman and Gentlemen of the New England Water Works Association:

It affords me great pleasure to welcome you on behalf of the Water Commissioners of the city of Springfield. The selection of our city as the place for holding this meeting is a compliment which we heartily appreciate. I trust your meeting will be pleasant for you, and that the information which you gain from each other will be such as to be of great

benefit to you and to the interests of those whom you represent. I have the pleasure to introduce our chief magistrate, the Hon. H. M. Phillips, Mayor of the city. [Applause.]

THE MAYOR'S ADDRESS OF WELCOME.

I feel it an honor, gentlemen, to perform the pleasant and agreeable duty of welcoming to our city the members of so honorable a body as the New England Water Works Association. It is generally admitted, I believe, that one of the most important departments in the government of a city is that which manages and controls its water supply, the health and prosperity of the city and of its citizens depending in no small degree upon an ample and well distributed supply of pure water. It is well, therefore, that you, as the representatives of this special department in our city governments, should assemble occasionally for the purpose of discussion, and to impart to each other any new and valuable information upon the special subject which may have come to your knowledge. I call this an honorable organization, and well I may, for, if an ancient pedigree can bring honor to any body of men, it seems to me you may lay claim to it. I remember reading of the building of water works or aqueducts,—and, surely no aqueduct can be built without its Board of Water Commissioners, registrar, engineer, superintendent and employees,—I remember, I say, reading that these water works, or aqueducts, were built for the purpose of supplying cities with water, way back in the earliest times, in Persia and Judea. The pools of Siloam, near Bethlehem, supplied water to Jerusalem, several miles away, and, I believe, one of these is used for that purpose now. You all know of the great Causeway of Montezuma, and of the stupendous works of the Incas of Peru, unequalled in ancient or modern

times, conducting water several hundreds of miles down from the mountains and through tunnels of solid rock. Beside these great works, even our largest aqueducts at Boston and Philadelphia and New York seem of little account. With all this ancient history behind you, it seems to me I am safe in welcoming you as honorable men, entitled to all the respect we can show; and I beg you will accept, on behalf of our citizens, my kindest wishes for the success of your meeting, with the hope that the benefits you may derive from it will be of interest to you all, and to the cities which you represent; and that when your departure shall come, at the close of the meeting, you may carry with you to your homes none but pleasant recollections of our city. [Applause.]

When I read the announcement of your meeting at 10 o'clock, I hoped to have the pleasure of remaining with you several hours, but the meeting having been postponed to this time, my duties at city hall require me to leave you now to my regret. I hope, however, to meet you all before your sessions close.

CALL OF THE ROLL.

The roll of the members was then called by the Secretary. The following named gentlemen responded:—

ACTIVE MEMBERS.

Benj. S. Babcock,	Superintendent,	Nashua, N. H.
William H. Barney,	Superintendent,	Milford, Mass.
William R. Billings,	Superintendent,	Taunton, Mass.
Julius A. Brand,	Superintendent,	Norwich, Conn.
Daniel S. Brinsmade,	Civil Engineer,	Birmingham, Conn.
J. C. Broatch,	Superintendent,	Middletown, Conn.
J. Henry Brown,	Supt. Charlestown Dist.,	Boston, Mass.
John C. Chase,	Superintendent,	Wilmington, N. C.
Robert C. P. Coggeshall,	Superintendent,	New Bedford, Mass.
Edwin Darling,	Superintendent,	Pawtucket, R. I.
Albert B. Drake,	City Surveyor,	New Bedford, Mass.
George A. Ellis,	City Eng'r & Registrar,	Springfield, Mass.

Albert S. Glover,	Registrar,	Newton, Mass.
Robert M. Gow,	Superintendent,	Medford, Mass.
Sherman E. Grannis,	Superintendent,	New Haven, Conn.
Frank E. Hall,	Superintendent,	Quincy, Mass.
Joseph C. Hancock,	Superintendent,	Springfield, Mass.
James H. Hathaway,	Registrar,	New Bedford, Mass.
Simpson C. Heald,	Civil Engineer,	Worcester, Mass.
Thomas A. Hodge,		North Adams, Mass.
Horace G. Holden,	Superintendent,	Lowell, Mass.
David W. Horan,	Superintendent,	Clinton, Mass.
A. H. Howland,	Civil Engineer, U. S. Hotel,	Boston, Mass.
B. H. Hull,	Civil Engineer,	Bridgeport, Conn.
Horatio N. Hyde, Jr.,	Superintendent,	Newton, Mass.
A. W. Inman,	Superintendent,	So. Weymouth, Mass.
Moses Joy, Jr.,	President and Treasurer,	Milford, Mass.
Willard Kent,	Superintendent,	Woonsocket, R. I.
Horace H. Knapp,	Clerk,	Lowell, Mass.
Addison Lane,	Superintendent,	Melrose, Mass.
Thomas C. Lovell,	Superintendent,	Fitchburg, Mass.
James W. Morse,	Superintendent,	Natick, Mass.
Hiram Nevons,	Superintendent,	Cambridge, Mass.
Albert F. Noyes,	City Engineer,	Newton, Mass.
F. H. Parker,	Superintendent,	Burlington, Vt.
Walter H. Richards,	Superintendent,	New London, Conn.
Daniel Russell,	Clerk,	Everett, Mass.
Henry L. Schleiter,	Superintendent,	Meriden, Conn.
C. W. S. Seymour,	Superintendent,	Hingham, Mass.
Geo. A. Stacy,	Superintendent,	Marlboro', Mass.
Lucian A. Taylor,	Commissioner,	Worcester, Mass.
Wm. C. Wilcox,	Clerk,	Watertown, Mass.
Horace B. Winship,	Civil Engineer,	Troy, N. Y.

ASSOCIATE MEMBERS.

Asbestos Packing Co,	169 Congress St.,	Boston, Mass.
Chadwick Lead Works,	171 High St.,	Boston, Mass.
Chapman Valve Mfg. Co.,	Boston and Indian Orchard,	Mass.
Equitable Water Meter Co.,	36 India Wharf,	Boston, Mass.
Wilbur D. Fiske (Agt. Knowles Steam Pump Co.),	44 Washington St.,	Boston, Mass.
Frost & Adams,	37 Cornhill,	Boston, Mass.
Jason Giles (Agt. Chapman Valve Mfg. Co.),		Indian Orchard, Mass.
Henry F. Jenks,		Pawtucket, R. I.
W. H. Marsh (Tuerk Motor Co.),	12 Cortlandt St.,	New York, N. Y.

National Meter Co.,	252 Broadway,	New York, N. Y.
Pettee & Draper,		Holyoke, Mass.
Peet Valve Co.,	163 Albany St.,	Boston, Mass.
Sumner & Goodwin,	21 Oliver St.,	Boston, Mass.
Wm. B. Sherman (Sec'y Corliss St. Eng. Co.),		Providence, R. I.
A. F. Upton (Jarvis Engineering Co.),		Boston, Mass.
R. D. Wood & Co.,		Philadelphia, Penn.
Henry R. Worthington,		New York, N. Y.

There were also present as guests, besides the Water Board and members of the City Government of Springfield, the following named gentlemen: —

Edward W. Cate,	President Water Board,	Newton, Mass.
Josiah Reed,	President Water Board,	Weymouth, Mass.
Arnold Welch,	Water Commissioner,	Lowell, Mass.
G. E. Winslow,	Superintendent,	Waltham, Mass.
H. R. Stanhope,	Supt. Construction,	Springfield, Mass.
E. C. Brooks,	Pumping Engineer,	Cambridge, Mass.
J. H. Walker,	Boston Machine Co.,	Boston, Mass.

ELECTION OF NEW MEMBERS.

The Secretary then read the following names of applicants for membership, which he said had been considered by the executive committee, who had voted to recommend them for admission to the Association.

FOR ACTIVE MEMBERSHIP.

Hiram Cutts,	Supt. Meter Div. W. W.,	Boston, Mass.
J. H. Decker,	Superintendent,	Hannibal, Mo.
Alphonse Fteley,	Executive Engineer, New Croton Aqueduct,	New York City, N. Y.
L. H. Gardner,	Superintendent,	New Orleans, La.
John Harris,	Commissioner,	Waltham, Mass.
Marshall M. Tidd,	Hydraulic Engineer,	Boston, Mass.
Frank W. Whitlock,	Asst. City Engineer,	Waterbury, Conn.
G. E. Winslow,	Superintendent,	Waltham, Mass.
Richard R. Yates,	Superintendent,	Northboro', Mass.
Milo Hildreth,	Treas. and Registrar,	Northboro', Mass.

FOR ASSOCIATE MEMBERSHIP.

Ludlow Valve Co.,		Troy, N. Y.
W. H. Gallison,	42 Oliver Street,	Boston, Mass.
Geo. H. Sampson,	231 State Street,	Boston, Mass.
Ashton Valve Co.,	271 Franklin Street,	Boston, Mass.

On motion of Mr. Horan, the Secretary was directed to cast the ballot of the Association for the admission of the gentlemen whose names had just been read. The Secretary did so, and the President announced their election.

The SECRETARY. While I think the members of the Association would indorse my action, if done unknown to them, I would prefer to act with their advice. We have upon our membership roll, under the head of Associate Members, the name of a gentleman who should, in my opinion, have been elected an active member. The gentleman's qualifications to be such are undoubted. I would, therefore, like the consent of the Association to transfer, from the list of associate members to that of active members, the name of William B. Sherman, of Providence, R. I. (Applause.)

On motion of Mr. Noyes, this suggestion was approved by the Association, and the Secretary was given authority to enter Mr. Sherman's name upon the list of active members.

THE PRESIDENT'S ADDRESS.

Gentlemen of the New England Water Works Association: —

As the pleasant June days return and all nature bursts forth into life; as the green leaves, the growing grain and singing birds tell us of the presence of summer, and on every side our eyes are gladdened by the beautiful colors in which nature decks herself on her escape from the chill of winter,— we have assembled in our fourth annual convention, to take counsel together; to recall the past, study the present, and lay plans for the future.

Although so young as a society, we already have a history.

Three years ago, at our preliminary meeting, some, even of those who wished us well, doubted if sufficient interest could be maintained to keep up our organization and to reap such beneficial results as the more sanguine expected.

But there is an old adage, that "Nothing succeeds like success." Scarcely was our organization perfected, before the advantages to be gained from systematic study and mutual interchange of experiences, became so apparent that a sufficient number joined our ranks to render ours a permanent addition to the number of professional associations.

With each year of our existence we have added to our stock of common knowledge, and while many of the weightier questions we are called upon to meet will scarcely be decided in the next decade, we have received new light on most of them as the result of our investigations, and are thereby better fitted to carry on the work of inquiry than we would have been had our studies been independent of each other and without the criticism that comes by comparing our own experience with that of others.

Of the year now just closing we can truly say that its record of what we have seen, learned and heard is one brim full of interest.

Adjourning from our third annual meeting at Lowell we assembled at Newton on the 24th of September, and through the kindness of our friends had the pleasure of viewing that beautiful city, perched upon more than seven hills and surrounded by valleys that not even Italy can surpass.

The fine display of their Fire Department, the efficiency of their Water Works, and the liberality of their citizens was witnessed and enjoyed by most of us.

On the 29th of January, in accordance with the advice of the executive committee, a meeting was held in Boston, at which members were afforded the opportunity, without formal discussion, of learning each others' experiences.

And last, on the 21st of April, in connection with our friends of the American Association, we attended in Boston the largest gathering of water works officials ever held in this country, and had a meeting which will always be marked with a red letter in our memories.

The papers and discussions to which we listened, the places we visited and the public works we saw, both in their number and magnitude, have never been surpassed (so far as I am aware) by what has been seen by any association in the United States at a single session.

That so much care and thought put into our meetings should have a tendency to increase onr membership and extend our field of usefulness is self-evident, and so we find it. A year ago we numbered 48 active and 9 associate members, a total of 57. To-day, having lost two, one by death and one by change of occupation, we number 83 active and 44 associate, making 124 in all, showing a gain of 70 members, and a total more than double that which we had when we met at Lowell.

By this increase of membership and by the change relating to the dues of associate members we have raised the amount of our annual receipts from $96 to $371, or 400 per cent., a change which will be of great assistance to our treasury and ourselves in defraying necessary expenses for printing reports, drawings, circulars, etc.

While now we congratulate ourselves upon our brighter prospects, we must not forget our increase of responsibilities. New England is to-day the most thickly settled portion of this country, and has by far the greatest number of water works in proportion to its area, so that as we increase our number, and thereby more and more thoroughly represent New England, it more and more devolves upon us to apply ourselves to the study of those problems that everywhere demand the attention of water works men, or more especially the public whom they serve.

Our experience of the past three years has shown us some of our weaknesses and the advisability of some changes, in order that we may attain the best results.

The first suggestion relates to our constitution. Continual tinkering of it is to be deplored, and it would seem as if with our present experience we ought to know pretty nearly what we need. I therefore recommend that our constitution be put into the hands of a committee for revision,

they to report in print at least a month before our next annual meeting.

It would seem desirable that the terms of our membership be so broadened as to admit as active members all who are actively engaged in the construction or management of water works. I confess that I am not one of those who are afraid of admitting any who have this interest, for it seems as if the greater the number interested the greater should be the benefits derived. Other matters require various changes, so that a reference like that suggested seems desirable.

The second suggestion (and this would be included in the first) is, that we need more frequent meetings. Our annual and fall meetings have become a settled custom, but it seems as if it would be advantageous to have at least two others, making our meetings quarterly.

Perhaps not all of us could attend each time, but the benefit to those who could would redound to the good of all, the interest would be stronger and our acquaintance better, and this leads to the third point.

When we get together each one should feel willing to *talk* to the extent of telling his own experience or giving such information as he may be possessed of. "But," says some one, "I cannot talk in public; I know about these matters, but I cannot speak about them." Well, now, I beg leave to say you can; you are among friends, as I have just said; you need to get acquainted, and so well acquainted that you will feel as ready to speak or talk before this association as you would in your own office or in your own house. "Oh, but it doesn't sound right; I can't express myself clearly." Well, my dear, brother, we are here to learn; if we wanted oratory we would call in a clergyman, lawyer, or a professional talker; but what do you suppose they could tell us about hydraulics?

How many of these gentlemen could shut a hydrant turning to the right to open? Or how would they succeed in performing any of the daily operations required on water works?

In short, it is *water works* and not oratory in which we are interested.

Our meetings should partake of the nature of experience meetings. It is facts, not words, that make up the sum total of our knowledge.

In the topics coming up for discussion at this meeting you are all interested. If you will each give the result of your own experience, so as to impress upon those of us who are doing our work in a faulty or inferior way the necessity of doing it rightly, you will have accomplished enough to fully justify us in leaving our work and meeting together in council.

In this way, only, can we secure our own growth, leaving to others to formulate in words better than we can the results of our observation and study.

REPORTS OF OFFICERS AND COMMITTEES.

Mr. Darling, for the Executive Committee, said the committee had decided it was not expedient to make any report this year, as the matters upon which it would naturally have reported, had been so fully covered in the President's address. The committee was excused from making any report.

The reports of the Secretary and of the Treasurer were then read by Mr. Darling as follows: —

SECRETARY'S REPORT.

Financial Statement of Albert S. Glover, Secretary, for the year ending June 1st, 1885.

DR.

To amount received for dues,	$103 00	
" " " " initiations,	435 00	
" " " " assessment levied on account dinner to American Association,	108 50	
		$646 50

CR.

By amount paid to Treasurer,	$646 50

Respectfully submitted,
ALBERT S. GLOVER,
Secretary.

TREASURER'S REPORT.

Financial Statement of Edwin Darling, Treasurer.

DR.

To balance on hand deposited in bank, as per report of June 18, 1884,	$132 85
" cash on hand June 18, 1884,	8 53
" accrued interest on bank deposit,	5 34
" amount received from Secretary during year,	646 50
Amount carried forward, ...	$793 22

Amount brought forward,			$793 22
Cr.			
Paid F. N. Owen, reporter,	$35 60		
" G. H. Pratt for:			
Printing proceedings 1884,	$106 80		
" service pipe date,	60 00		
" proceedings of Jan. 29, 1885,	19 60		
" pamphlets, constitutions, letter heads, notices, etc.,	57 25	243 65	
" A. S. Glover, Treasurer Entertainment Committee, amount collected from assessments for dinner,		108 50	
" A. S. Glover, for sundry cash expenses as follows:			
Short-hand, type-writing and clerical work,	43 60		
Telegrams, $1.08; postage, $12.05; express, $1.40,	14 53		
Paper, $1.65; printing, $1.50; messengers, $1.77,	4 92	63 05	
" Charles H. Stacy for:			
Postage, $10.00; wrappers, $1.98,	11 98		
Telegrams,	2 83	14 81	
" H. E. Winship for trunk,		8 00	
" Albert S. Glover, travelling expenses,		37 83	
Deposited in Savings Bank,	138 19		
Cash on hand,	143 59	281 78	
Total,		$793 22	$793 22

Respectfully submitted,

EDWIN DARLING,
Treasurer.

Springfield, June, 18, 1885.

Approved by Finance Committee:

James H. Hathaway,
J. Henry Brown,
Thos. C. Lovell.

The Secretary next presented the following report from the Entertainment Committee: —

REPORT OF ENTERTAINMENT COMMITTEE.

Mr. President and Gentlemen:

The Committee appointed by you on the 29th of January, to make arrangements for the entertainment of the American Water Works Association, having concluded its labors, beg leave to make the following report:

Under authority of your vote, passed January 29th, Messrs. Jason Giles, Wilbur D. Fiske, A. H. Howland, Albert F. Noyes and C. H. Baldwin, were joined to your committee at its first meeting. Also at this meeting, after a discussion as to the best manner of carrying out the desires of the Association in the manner of entertaining the American Association, and the amount of discretion your committee had in the matter, the Association having decided merely to give an inexpensive dinner, we came to the conclusion that provided we entailed no expense to the Association exceeding the income from the $2 assessment which had been levied by the Association, whatever we might undertake, if carried out successfully, would meet your approval. Having arrived at this conclusion, we then determined that we would endeavor to extend a little further hospitality to our guests than at first contemplated; to make the dinner more elaborate; to invite some of our representative men to help welcome our guests, and to aid to the extent of our ability, the resident committee of the American Association in carrying out the arrangements made by them for the excursions and tours of inspection on the days during the convention succeeding the dinner. To do what we planned to do, we

realized, would take considerable money; but we were saved the embarrassment of planning in the dark by receiving from Messrs. Giles, Fiske and Howland a guaranty to raise the money necessary to the carrying out of our plans, as then outlined, estimated to be $2500. Primarily to the generosity and energy of the gentlemen named is attributed, by the majority of the committee, anything of credit which may have accrued to our Association from this pleasant occasion; to say this we feel is not detracting in any way from the credit due to our numerous friends who so very generously contributed toward the finances needed; nor from that due to our members and other gentlemen who so kindly assisted us in the labor of perfecting and executing our plans. It is the intention of your committee to prepare for publication, with the report of this meeting, a full report of our meeting in April, containing, with other records, those of the post-prandial exercises on April 21st, and here our labor ends. Appended is a statement in detail of the receipts and expenditures of the meeting, showing a balance, we are happy to say, on the right side.

In conclusion, gentlemen, we may say that our labor has been a very pleasant one, and that we shall be very ready at any time to undertake a similar responsibility. We plead guilty, *sub rosa*, to having just the least possible mite of pride in the success of the entertainment; but we also fully realize that this success, this "open sesame," to our appeals, this remarkable attendance of prominent and representative guests, this very large accession to our membership roll has been due, not to our labors, gentlemen, not to us personally, but to the high standing, good character and growing fame of the New England Water Works Association.

For the Committee,

F. E. HALL, *Chairman.*

The PRESIDENT. I can find but one fault with the report, and I think the Association will agree with me in it, and that is that our worthy Secretary is altogether too modest. [Applause and laughter.]

The report was accepted and placed on file, and, on motion of Mr. Coggeshall, the Association voted to record its thanks to the committee for the manner in which it had performed its duties.

The next business in order was the election of officers. Mr. Horan moved the appointment of a committee of five by the Chair to nominate officers for the ensuing year. The President appointed Messrs. Horan, Hall, Taylor, Noyes and Grannis. On motion of Mr. Horan, the committee was directed to report at the evening session.

Mr. SHERMAN. I see by the programme that time is allotted this evening for the discussion of miscellaneous topics, and I think that would be a very appropriate time to consider the sketches which may be handed in. I would suggest that any of the members who have prepared sketches bring them at the assembling of the afternoon session, so that the Secretary may get them together and distribute to each member a complete set. Then, in the interim, the members will have an opportunity of looking them over, and they may find something in them which they would like to inquire about at the evening session, when the hour for the discussion of miscellaneous topics arrives.

On motion of the Secretary, the Association then voted to take a recess until 2 P. M.

AFTERNOON SESSION.

Mr. Darling moved that so much of the President's address as related to the By-Laws be referred to a committee of three, to be appointed by the Chair, to report at the next annual meeting.

The Secretary moved to amend by directing the committee to report in print, in accordance with the suggestions of the President, at least a month before the next annual meeting.

The amendment was accepted and the motion adopted. The President appointed the following gentlemen to constitute the committee: Messrs. Darling of Pawtucket, Glover of Newton, Hall of Quincy.

WEIGHTS OF CAST-IRON PIPE.

The first topic upon the programme was "The Weight of Cast-Iron Pipe for all Sizes and Pressures, as deduced from Pipe in Service; to be ascertained by correspondence and shown by diagram." The opening paper was by Albert F. Noyes, Esq., City Engineer, of Newton, Mass.

[For this paper see end of Report.]

Mr. HOWLAND. This is a subject which has attracted my attention considerably for the last few months, as I had, as Mr. Noyes has told you, the duty of preparing a paper upon it for the April meeting of the American Water Works Association. The replies obtained to my inquiries were most unsatisfactory. Upon this question which Mr. Noyes brings up, in relation to water hammer, I could get no reliable data. Three gentlemen replied substantially in these words, "I do not know what the pressure has to do with the weight of pipe;" others would say, "I don't know what the water

hammer has to do with the weight of pipe;" a good many would reply, "We use standard weight of pipe;" and a good many would reply that they use pipes made by such and such manufacturers. Such replies displayed a large amount of ignorance, I am very sorry to say, among those who have the care and management of water works. It is of the utmost importance that we should know, if we can find out, what is best to use under the varying condition that pipes are subjected to, and if a committee could be appointed which could obtain any reliable data, from tests or experiments, it would be of great benefit to us and to the general water works public.

I think the tendency among the majority of engineers in this country has been to use too heavy pipe. When we got a report from a place having a maximum pressure of say 100 lbs. to the square inch, with a recorded water hammer of 50 lbs. more, where they use a 6-inch pipe, weighing but 26 lbs. to the foot, a good many of us open our eyes and think that is rather light; that we would not dare risk it. But the fact remains that such pipe, in large quantities, is in use to-day and has been in use for years. If that is the case what is the need of using 6-inch pipe weighing 41, 43, and in one case 48 lbs. to the foot? If 26-lb. pipe will stand 150 pounds' pressure in Massachusetts it ought to stand the same in Rhode Island. I think the tendency has been to put altogether too much money in insurance by using too heavy pipes, and if we can get the data suggested by Mr. Noyes it will be of very great value to us.

Mr. Joy. Some data have accidentally come to me bearing upon this subject, which perhaps may be of service to us. We have in Milford, the Holly pumping system, which, as a direct pumping system, I suppose subjects the pipes to the very hardest service that any pipes are subjected to.

The railroad company, whose station is in the lowest part of the town, wishing to take water from us, we put in for them one of the ordinary railroad pipes with a 4-inch opening in it. They had what they claimed was an automatic closing valve, which would close slowly. But the engineers would be in a hurry and would not wait for that to operate, and I have noticed them a good many times sitting on the lever to close it. A short distance from the railroad pipe was a factory which was using our water for their boiler purposes. They put on a guage to determine what pressure they had, and to know when they could run it into their boilers. There were times when they could run it in without resorting to any means of forcing it, either by inspiration or direct pumping. They have told me that when the railroad people closed their stand-pipe, the pressure on the factory gauge, although the pressure at our pumping station is supposed to be as near 70 pounds as we can get it, often recorded more than 200. The gauge was set at 175, and it bent the handle on the gauge, so that they had no means of telling exactly what the pressure was.

Now we use in Milford what, in comparison with some of the weights of pipe, are very light. We use 4-inch, 18 pounds; 6-inch, 30 pounds; 8-inch, 44 pounds; 10-inch, 60 pounds; 12-inch, 78 pounds; 14-inch, 99 pounds. When we made the test there, the exhibition for the town, I borrowed of Mr. Morse in Boston a large nozzle, and we put on three streams from three different hydrants. We ran the pressure at the pump up to from 170 to 180 pounds, and we threw a 2-inch stream of water 156 feet high by actual measurement. Then we shut off moderately; but the engineer told us that the gauge jumped to more than 200 pounds.

These facts, as I say, came to us accidentally without our having sought them, and, thinking that they might be of information and use to you, I have given them. I will say this, that we never had a pipe burst that we supposed was sound. When we first turned the water on we burst some four or five pipes, but two or three of them showed coal-shots, and one or two showed what we supposed were old cracks. Since then we have tested them thoroughly, and we never have had any break. We have started our lead once or twice; we did so two or three times before we stopped the railroad company from using the hydrant and creating so much water hammer, but we never have cracked or broken a single pipe.

Mr. LOVELL. It seems to me the point we wish to bring out is this: How light a pipe, under a certain head, will it be economical to use? I have had but very little experience in cast iron pipe, but we use our pipes under from 200 to 400 feet head, and I will give the weight: Four-inch pipe, 22 ponnds; 6-inch pipe, 32 pounds; 8-inch pipe, 52 pounds; 10-inch pipe, 65 pounds; 12-inch pipe, 93 pounds; 16-inch pipe, 123 pounds. We never have had any trouble with pipes breaking, except as the gentleman before has said.

Mr. DARLING. I don't suppose it will be any information to any of the gentlemen who have ever visited pipe works, and seen the pipes tested there, but every pipe, whatever thickness is called for, whatever weight is called for, is put to a 300-pound test. I suppose any superintendent who has ever visited pipe works has seen that done. I have seen them carried up to 400, and they would have gone higher, but I didn't care to stand there. Every manufacturer of pipe will tell you that he will put under a 300-pound pressure test every pipe that is cast. I may say that, with a pressure valve of from 65 to 135, they originally put into our works a

26-pound 4-inch pipe, 36-pound 6-inch pipe, 50-pound 8-inch pipe, 75-pound 10-inch pipe, and 90 and 95-pounds for 12-inch pipe. I use now 22 for a 4-inch, 30 for a 6-inch, 40 to 45 for an 8-inch, 65 to 70 for a 10-inch, and 80 to 85 for a 12-inch. We connected on to an old 6-inch force pump pipe, in one case, about a mile long, in what is called the Central Falls Division of the works, and that pipe only weighed 22 pounds to the running foot, and it has stood for six years, and we never have had any difficulty with it. I presume that that pipe was originally put under a 300 pound test. I have reduced my weights from what they were originally, because I didn't think there was any necessity for having them so heavy. I think that 28 pounds for a 6-inch pipe is sufficient to carry anything you want to. I believe that is the practical working of it.

Mr. BILLINGS. I can think of no subject on which a committee of this association might spend their labor more profitably and produce better results, than in determining what conditions exists when bursts take place. It seems to me, from what little I can learn, that bursts of cast iron pipe are not very frequent, and a careful study and classification of the conditions under which they do take place would be of value. Mr. Baerman, I think he is of Troy, N. Y., recently read a very interesting paper before the Engineers' Club of Philadelphia, which many of you have seen, probably; and he concludes that the lightest weight which it is safe to handle, in four and six-inch pipe, is heavy enough to stand any of our ordinary reasonable pressures. He gives the minimum thickness. It seems to me this association has reached a point where a committee might properly make tests, and, if the funds of the association will allow it, spend a certain amount of money in that direction. If the funds will not allow it, I think some of the departments would con-

tribute; I will venture to say that Taunton will give something toward paying the expenses of finding the bursting point on fair samples of pipe, and also of determining the water hammer, by means of records of some kind. I hope the suggestion for a committee will not be lost.

Mr. CHASE. The water company that I represent here has some of these light pipes in use, and subjected to the pressure that has been mentioned here, of from 125 to 150 pounds as a maximum. We carry a domestic pressure of from 30 to 50 pounds, and, in case of fire, shut off the stand pipe and pump direct. I have a Hudson recording guage in my office, and I never have noticed a pressure higher than 150 pounds at any fire, when the hydrants have been shut off more or less quickly, and generally pretty quickly. When a hose bursts, for instance, we can tell when the hydrant is shut off, by the immediate increased pressure, which is a matter of 20 or 30 pounds. The weights we use run about as follows: Four-inch, 16 pounds; 6-inch, 28 pounds; 8-inch, 44 pounds; and 12-inch, 75 pounds. I have been obliged to buy pipe since we laid the works, and in order to get it in time have had to buy heavier pipe; but it was against my judgment, and it so happens that the heaviest pipe is used on the highest ground, where the least pressure is. I can give one little incident that may be of some interest. We were laying four-inch pipe on the lower level, and it became necessary, in order to fill in, to cut off about three feet from an ordinary length of pipe, and it happened to be our last pipe. We first made a mark with a chisel about a sixteenth of an inch deep, to know where to cut, and at the first heavy stroke to do the cutting, the pipe snapped off short like a pipe stem. It was the only pipe we had, and so we ran the risk and put it in. We never have heard from it since, and it has been subjected to about as heavy a pressure

as any, I should say, in the neighborhood of 160 pounds.

This might be considered of value as a practical test. But, really, I do not consider it worth anything, for the reason Mr. Darling gives, that the pipe has all been tested at 300 pounds at the factory. If the makers are willing to furnish light pipe, and guarantee it to stand a strain of 300 pounds to the square inch, there seems to be no reason why the consumer should hesitate to take the lightest weight they will guarantee, so long as he is confident his pressure will not exceed it, making the proper allowance for water-hammer. I know nothing about the excessive pressure from water-hammer that the other gentlemen have spoken of, for that has not been under my observation. There is one other point in this connection, however, which may be of interest, and that is with regard to the depth of lead joints. We hear a good deal said about deep joints, and picked Italian hemp, etc.; but we use old rope down our way, which we buy for three cents a pound, and as I happen to know that the contractor who built the works didn't use but about an inch and a quarter depth of lead, I never have used over an inch and a half in an ordinary joint. We have had only one joint blow out, and I don't think one per cent. of the joints that have been made have ever leaked. Though this is rather foreign to the subject immediately under discussion, I speak of it as a practical question.

Mr. NOYES. There is one thought suggested in the paper that I did not dwell upon, and that is the importance of requiring the iron to be of a certain tensile strength, and of having it carefully inspected as it is made at the foundry. I believe fully that we can safely reduce our weights very materially if the tensile strength of the iron is required to be fully up to the standard, which, as most engineers now agree, is something like 16,000 pounds to the inch, and if there

is a careful inspection at all points, especially as to the thickness of the pipe. Passing some 30-inch pipe that was being laid, a few weeks ago, I noticed one that had been broken, and I thought I would look at it to see how its different parts compared in thickness. There was a piece which may have been a foot or 15 inches long, and by calipering it I found one side to be between 3-10ths and 4-10ths of an inch thick, and the other side to be 8-10ths of an inch thick. Although this pipe had presumably passed inspection, it yet showed that variation. It seems to me that one thing of the utmost importance in making an inspection is the careful calipering of the pipe throughout its whole length. That one matter has a very important bearing upon the economical construction or extension of our works.

Mr. SHERMAN. Speaking right to the point of the necessity of calipering pipe, I would state that it was my good fortune to be inspector of pipe for about a year, and I do not see the necessity of so much nicety of result as would be obtained by calipering. If the socket end of a pipe cast vertically is rightly entered, and it must be in order to fit, it must be right at that end. The upper end is fixed by a sand ring, and it must be a piece of utter carelessness to get that out. Such a thing may have occurred in casting the pipe Mr. Noyes speaks about. But it can be easily determined whether the pipe is out of true, thick on one side and thin on the other, by having two perfectly even skids, at just a slight declination, along which the inspector rolls the pipe after it has been cleaned. You can determine that way as well as you can by calipering whether the pipe is out or not. If it is true you can roll it right along, and it will stand at any point. That is, chalk the end, and you can roll it along a short distance, two or three feet, and it will stop at one point; roll it along two or three feet further

and it will stop at another point if it is perfectly true in its construction. I think with the skids nicely adjusted you can detect the inequalities of the pipe as well, practically, as you can with a pair of calipers. If it is right at both ends it must be right in the middle, that is, down to a 3-inch pipe. Of course, in a 2-inch pipe, 12 feet in length, the core may spring in the middle, but I don't think a 3-inch pipe ever will.

Mr. STACY. I should like to inquire if the water-hammer in a pipe has the same effect upon it that the same pressure, gradually raised by the pump, would have? That is, whether a sudden closing of a valve, bringing the water to a dead stop, has the same effect on the pipe, to raise the pressure say to 180 pounds, as it would if you gradually raised that pressure with the pump? Whether there is any more danger of its breaking?

The PRESIDENT. Can some gentleman give information on that point? (Pausing.) If I was to attempt to answer it myself I should say it would depend, partly, upon how sudden the shock was. That is, if it was instantaneous, in the nature of a blow, the result would be different than from pressure. But allowing 30 seconds, perhaps, to receive the natural impulse, I don't know as it would be very different from the pressure from a pump. In any considerable length of pipe it would take from 30 seconds to, perhaps, a minute to reach the maximum strain, and where that occurred I should not suppose it to be in the nature of a blow. But if the line of pipe was so short as to receive the strain almost instantly then it would partake of the nature of a blow rather than of a steady strain.

Mr. SHERMAN. I think, as Mr. Darling has said, that a pipe which is made to sustain a pressure of 300 pounds at the factory is subjected to a more rigid test, if the test is carefully carried out, than any it receives in the ground. The pipe is

simply pressed together endwise, being held in position by two skids. There is no superincumbent earth, and nothing to help it bear the strain. The pressure on a 4 or 6-inch pipe would almost have the tendency to buckle it as it is pressed together. And I maintain that the test that the foundrymen make on their own premises of 300 pounds is more rigid than any test the pipes ever receive in the works. The pressure is put up more suddenly than I can conceive of its being done by any machine connected with water-supply distribution. I can't conceive of anything that could be made to apply so quickly as the hydraulic pipe.

Mr. DARLING. I might, perhaps, add one word more. It has been suggested that we have a test made to see how much a pipe will stand. Now, I would say to any superintendent that he can visit any pipe works—he may go to the Warren, R. D. Wood, Gloucester Iron, Star, or any place wherever pipe is made—and they will put the pipe on for you, and test it up just as high as you want them to, just as high as you will dare to stand there and see it tested. And they not only do that, but they take a hammer and go right along and strike on the pipe from one end to the other. I have seen hundreds of pipes tested in just that way. Some people say they don't believe all pipes get that test, but I believe they do. I believe the manufacturers are honest about it, and they do what they say they do. Why do I believe that? Because I have been in the works when the manufacturers did not know what I was there for, and did not know me at all, and I have seen them testing the pipes. I have stood right by and seen the gauge carried up to the 300 every time, and from that above, just as the man happened to be striking the pump. It is all done in an instant almost, and they run it up from nothing to 300 in less than a minute, and then they take the hammers and walk

along and strike the pipe all over. And I have seen a case where, as I say, I asked them to go a little higher, and they ran it up till they got up so far I didn't want to stand there, and I got out of the way. Now there is not a superintendent who cannot, if he will take the pains to visit one of these places (and it won't cost a great deal either), have his pipe tested up to any point he wants to see it tested to. They will give 300 anyway; they expect to do that on anything you call for, and they are perfectly willing to guarantee that, and they will tell you that if one bursts in the ground you can take it out and charge the expense to them, and they will pay it.

Now, I can't see any necessity of our making any tests. I don't know how we could rig up anything to test a pipe in the ground after it is laid, to better advantage than you can see it done at any pipe works you may visit. And as to water-hammer, as I say, when the pipe is up to its pressure, they will take a good-sized hammer and go right along and strike the pipe a good blow, from end to end, so I don't think there is any trouble about the pipes we receive having been sufficiently tested. Of course, there are accidents in the cartage of pipes. They may get cracked in the bell, or they may get a blow in the spigot end, or they may get a blow in the centre of the pipe, that you don't detect when you put it into the ground, but which will show when you come to put your pressure on. But it is very seldom that that happens. If the layer of the pipe is careful and prudent about it, examines his pipe well, I believe it is the experience of superintendents here present, that they do not have many of such cases of accidents in laying new works or in making additions to their works. I fully agree with my friend Mr. Sherman, that there is no test in the ground that can equal the test which the manufacturers give. They make it more

rapid than an engine could possibly do; they run it up to a high pressure a great deal faster.

Mr. JOY. I should like to see the suggestion that Mr. Billings of Taunton has made to us carried out, and have a committee appointed to visit some foundry. I am sure any foundry will allow them the use of their apparatus for tests. Perhaps it might not be of any use to some of the members, but it would be of great use to me personally. I build works for the dollars and cents I can get out of them; and if I am putting into the ground pipes that weigh from 2 to 5 or 10 pounds a foot more than is necessary, it would save me a good deal of money to know it, and I would be willing to contribute liberally for the expenses of any committee. If any one else can get any good from it, I should be happy to have them get it. I hope that if there are any members here who would like to have these tests made, they will express their views, and if we can get enough to warrant it, we will have them made.

Mr. HOLDEN. I would like to inquire if there is any superintendent here who has ever had any trouble with cast-iron pipe breaking. We have about eighty miles of cast-iron pipe, and during the past seven years I have had but one break, and that was in a pipe which had been laid about eight years, and where the pressure was not over 20 or 25 pounds. It is the same weight as all our other pipe is, where, in some places, the pressure is 70 pounds. That is the only pipe we ever had break on our works.

Mr. BILLINGS. I suppose there is not a gentleman here who is not of the opinion that too heavy pipe is generally used. I have had the pleasure of seeing the testing at the foundry, as Mr. Darling describes it, and it is certainly a sufficiently severe test, and, as Mr. Sherman rightly says, probably no test the pipe ever gets in the ground equals it. But the

thing that troubles many of us is that we have got to convince men who know little or nothing about matters which we have all been made familiar with by such papers as Mr. Howland and Mr. Noyes have written. We must have something which we can show to the water commissioners, and the water committees, which will convince them that they are spending too much money for insurance in pipe. Now, I did not expect that this committee, if it made any tests, would make them with the ordinary weights of pipe. Perhaps I did not explain myself fully enough. Mr. Fanning gives in his book seventeen different formulæ for the thickness of cast-iron pipe. I think it would be worth while for this Association to determine by experiment which one of these formulæ is nearest the truth on the average iron that the foundries turn out. I have found, in my limited experience (and the older men probably know it much better than I do) that there is nothing like a set of experiments to convince men. A few experiments are worth volumes of argument. And if this Association could investigate the 17 formulæ which Mr. Fanning has in his book, and show that one or two of them were nearer the truth than any of the others, and establish the fact that pipe of a certain thickness ought to stand a certain pressure, we can then throw the responsibility of their failure back on to the foundrymen, or on to the transportation companies, and buy our pipe with confidence that it will be up to the standard of the pressure we want to subject it to.

Mr. TAYLOR. I have investigated the subject of cast-iron pipes to a considerable extent, and I am of the opinion that we do use heavier pipe than is necessary. Still, there is one test, which, perhaps, none of us have fully tried, and that is the matter of time. Of course, if we are are to put in cast-iron pipes to lie 100 years or 50 years, we must take into

consideration the effect of corrosion, and the undue strain or pressure which may be brought upon them by other excavations, the settlement of the ground, or any other cause, and we must guard against such contingencies. I think that is a point that should be carefully considered.

Mr. PARKER. We have a water in Burlington that is very corrosive to certain kinds of iron. I had occasion to cut an 8 inch pipe the other day, and I found tubercles of rust about the size of the end of my thumb. In scraping those off I found the iron was all right, with the exception of a small hollow, where I could take my penknife and dig right into the pipe, perhaps, a sixteenth of an inch. We have taken out some gates and some meters, and have found the iron so soft that we could bore it with a screw-driver a quarter of an inch. Now, if this iron is going to work like that, the question is, ought not some allowance to be made for the effect of corrosion. We have some pipe which has been in use from 30 to 35 years, which is very badly rusted on the inside, but which shows no evidence of any such corrosion as we find in this pipe of later make. It has occurred to me that possibly the manufacturers are using a different kind of iron now.

Mr. JOY. I should like to ask the gentleman if he has ever had any analysis of his water to tell what the trouble is.

Mr. PARKER. We have had analyses made, but, so far as they show, there is nothing that will account for any such action as we have noticed. The water is as pure chemically as is furnished by any water company in the country, I suppose. It is Lake Champlain water, but it has this peculiar effect upon the iron.

Mr. JOY. No magnates or sulphates in it?

Mr. PARKER. No, sir.

Mr. GRANNIS. In answer to Mr. Holden, I would say I

have an 8-inch pipe, under a pressure of 103 pounds, weighing 41 pounds to the foot, which has been in use seven or eight years. One was split from end to end by water-hammer, caused by the careless closing of a hydrant, and on examining it, I found it had a thick and thin side, and the thinnest side was 3-8ths of an inch thick.

Mr. NOYES. In answer to the remarks of the gentleman on the other side of the hall (Mr. Parker), concerning the corroding of the iron, I would say that I recently heard a very interesting paper on that subject, before the Engineers' Society of Boston, by Prof. Nichols. After having studied the subject for some months, it still remained an unsolved problem. Yet there were some very good suggestions in the paper. The subject was brought especially to his attention by receiving a specimen of pipe, taken out of the Fall River Works, that had changed to what might be called plumbago, or black lead. In answer to Mr. Darling's remarks, as to the pressure or strain that a pipe is subjected to, I would say that we are all probably well aware that the theoretical tensile strength of even the lightest pipes is very far in excess of any test they are put to at the foundry. For instance, if any of us were to take the trouble to estimate the theoretical strength of a pipe with even a low tensile strength, we should find it would run well up into the thousands of pounds; whereas, the pressure in the test that it is put to at the foundry, is 300 pounds or more. My attention was first called to that by an inquiry as to whether it would be proper to put a certain light weight pipe under a higher pressure than it was designed for, and having occasion to figure it, I found its theoretical strength was some 10 or 15 times the strength it would have to be called upon for, and I reported that in my judgment it was perfectly safe. It has been in some five years, and we never have heard anything from it.

There is, at the present time, and should very properly be, a very large allowance made for corrosion; and if a committee should be appointed to investigate this general subject, I think the inquiry would probably extend to this particular point, and the strength of pipes which have been in for a long time could be determined, although it might not be possible to find out what was the tensile strength of the iron at the time of its manufacture. Such information would certainly be of interest to us all.

Mr. DARLING. One word more with regard to the life of a pipe. I have not yet been able to find out, either in this country or in other parts of the world, what the life of an iron pipe is. The oldest water works in this country are in Baltimore, where the pipes have been laid more than 60 years. There are pipes in Philadelphia, which have been laid for 50 years. I visited the Philadelphia Water Works about four years ago, and in traveling about with the superintendent, I came to a place where they were replacing a 6-inch pipe that had been in the ground for 50 years, with a larger line. The old pipe was apparently in as good condition as the day it was first laid, and they were relaying it in streets where they would be large enough to furnish the required supply. I saw them in Baltimore taking out pipes that had been laid 60 years, and they were relaying them in other streets. I cannot find in any history the life of a pipe eight inches or larger. Of course, a 4-inch pipe will corrode, but I can find nothing which fixes the life of the larger pipes. And yet, I have a piece of pipe at home that was sent to me from Fall River that had only been in the ground six or seven years, and you could whittle it with your knife, just as you can whittle lead.

Mr. SHERMAN. I don't want to do too much of the talking, but I should like to ask the gentleman from Burling-

ton if he finds the same amount of corrosion in the pipes, in the gates and in the meters?

Mr. PARKER. The pipe I spoke of has only been laid four years. The gates and the meters that are so bad have been in from 10 to 15 years. The question with me was whether this corrosion was going on in the pipes the same way it was in the gates and meters, and if so, where it would end.

Mr. SHERMAN. Supposing the pipe was in use about the same time as the gates and the meters, at the rate it is proceeding, would you judge that the amount of corrosion would be about the same?

Mr. PARKER. I infer it would, if the iron was about the same quality.

Mr. SHERMAN. Well, establishing that point, Mr. President, it looks to me as if it was not the fault of the iron. If we had one case where the water had acted on it, we might say it was a poor quality of iron. But here are three kinds of iron, as we may safely say,—iron that was furnished by the pipe maker, iron that was furnished by the valve maker, and iron furnished by the meter men. Now those three, probably were not the same qualities of iron, so we must look for something in the water to account for the corrosion, and cast aside, in the case of Burlington, the theory of any imperfection in the iron.

Mr. NOYES. I think wherever you find these tubercles you will find soft spots beneath them. I know it is so in our pipe at Newton, and I think that is the general experience of those who have observed it particularly.

Mr. CHASE. There is a gentleman sitting behind me who has been connected with the manufacture of apparatus used in connection with water works, and who has had large experience in making repairs, and I would ask that he be

allowed to say a few words, Mr. Walker of the Boston Machine Co.

By request of the President, Mr. Walker addressed the convention. He said: —

In my experience in repairing gates and hydrants, and other works connected with water works, I have seen a good deal of this corrosion, and some cases where it has covered the whole inner area of a gate or hydrant, so that it was impracticable to repair it. I have noticed it particularly in the Mystic Works, and also in the Boston Works. I have seen the same thing, to a greater extent, in iron valves and pipes in sugar-houses, where salt water is used, and you all know how destructive of iron that is, and it was in the shape of plumbago, as has been spoken of.

Mr. BROWN. We talk about breaking cast-iron pipes, but we don't know much about it after all. I happen to have a line where we have got a good deal of mud pipe and some cast iron. We have got a line of 24-inch cast-iron pipe from the reservoir into Charlestown, laid a little over 20 years ago. A year ago last winter we had two breaks on that line. One was on the top of Winter Hill. It took us three or four days to locate it, and we found the pipe was completely cracked, although we could find no settlement Come to get the pipe out, we found it was something similar to that of Fall River. The pipe was laid through an old ledge, full of iron pyrites, and the pipe was being gradually eaten out. Sooner or later we shall have to relay the whole section. About a year ago we had a bad break on Broadway, Somerville, near the railroad track. We found that a piece of 24-inch pipe, 8 feet long, had blown out the side of the pipe. On examination we could find no flaw in it, nor anything to explain the matter. The bare fact that the piece blew out was all that we knew. We found these tubercles

that have been spoken of, but it was a coated pipe. The tubercles were not over 3-8ths of an inch thick, and when I scraped them off, I found that the iron had not been eaten into more than a sixteeth of an inch. But, as Mr. Walker truly says, the Mystic water is pretty hard on cast-iron pipes. Wrought-iron pipe is very short-lived with us. But I have found that 24-inch pipe which was coated when it was first laid down is, in most places, as good now as when it was first laid.

Mr. CHASE. The remarks about corrosion bring to my mind a little personal experience. A service pipe, which had been in use only about a year, began to leak, and was taken out. It was found to be pitted on the outside with depressions about the size of a bird-shot, and some of these had gone entirely through. It was very puzzling to account for at that time. We have since learned that about 15 years ago, some stuff that had come in ballast had been distributed over the surface of the street, and it had proved so detrimental to the feet of the horses travelling over it, the city had been obliged to give it up. The city lost two or three valuable horses by hoof-rot. No one ever could tell what it was, except that it was some ballast which had been put on the street, and I have been waiting with considerable interest to know what effect it is going to have on the cast-iron pipes. Perhaps one of these days I may have something to say about plumbago. There is one point Mr. Sherman mentioned,—about the test underground not being as severe as at the foundry. That may be the case up here, where you are getting your pipe two or three stories underground, because the frost is going deeper every year; but with us, where we lay them almost on the top of the ground, we don't get much of a factor of safety from the earth.

The PRESIDENT. I think we must all be reconvinced of what we knew before,—that our practice varies very much. And I think we ought not to forget the point that has been made by some of the speakers, that it is a duty we owe to the communities we serve, to find out what the economical limit is. Of course, if our pipe is buried in ground in which it is going to decompose, it will decompose, whether it be thick or thin, and how much or how great a factor it may be nothing but experiment can show. But if a community is expending $20,000 a year for pipe, and $3,000 of that is practically wasted, it is certainly enough to pay the salary of the superintendent, unless he is paid a better salary than most of us get. I believe the suggestion that a committee be appointed to investigate this matter is a very good one, and I would inquire of Mr. Billings if he has made it as a motion, or in what shape he intended to leave it.

Mr. BILLINGS. I threw it out as a suggestion, but, if the chair desires, I will make it as a motion, that a committee of three be appointed by the chair to make experiments, and report at the next annual meeting, so far as they may be able to obtain any information regarding cast-iron pipe, its life, and such matters as have been brought up in the discussion.

Mr. JOY. Of course that committee will have to have some funds to enable it to pursue its investigations. As I said previously, I should be willing to contribute liberally, privately. The question arises as to what the Association will be willing to appropriate, or what others will give, and how far the committee can go. I think that if the members of the committee give their time and labor, it is asking a great deal of them, without expecting them to be put to any expense in the matter personally. There will undoubtedly be travelling expenses, and some expenses in connection

with any experiments they may make. I think, upon application by the committee, in the name of the Association, any of the foundries would be willing to aid them, and would place at their disposal such apparatus as they have for testing. But they may not feel that way, and, certainly, they may not feel like furnishing samples. We may have to pay for samples, and some one has got to pay the travelling expenses, etc., of the committee. It would be cheaper to do that than to erect apparatus of our own.

Mr. CHASE. I was going to suggest the propriety of this committee obtaining samples, if they could be had, of pipe that has been in use a certain length of time. I imagine most any water department, which is interested in this work, would be willing to give a sufficient length of pipe that had been used for a test. That would be of some value as bearing upon the question of the effect of time, and the experiment would be worth as much practically as an experiment with new pipe would be. I have no doubt some of the foundries would be very glad to tender such facilities as would be needed for making the test, and to furnish us all we need in the way of material.

Mr. JERRICKS. As a representative of R. D. Wood & Co., I would extend a cordial invitation to whatever committee may be appointed, to visit our foundry and make whatever investigation they think proper to make.

Mr. CHASE. I suppose that means the use of the apparatus for testing samples?

Mr. JERRICKS. Yes, sir.

The Association then adopted Mr. Billings's motion for the appointment of a committee, and the President appointed Messrs. Sherman of Providence, Noyes of Newton, and Howland of Boston. Mr. Sherman asked to be excused from serving, but by an unanimous rising vote the Association refused to grant his request.

Mr. Joy moved that the committee be authorized to draw on the Treasurer for $100. Inquiry being made as to how much money there was available, the Secretary said there was a balance of between $220 and $230 in the treasury, and that the income for the year would be a little over $400. I should think, continued the Secretary, the Association might safely count upon a balance of $100 available for the purposes of the committee, if the necessary funds could not be raised in any other way; but it seems to me it would be desirable to leave a balance in the treasury, and I think it would be a very easy matter to raise what money the committee would require from the cities and towns which will receive the benefit of it from any information obtained. I feel very certain in stating that the city of Newton would not hesitate to subscribe $50, and the whole expense ought not to exceed $300.

Mr. CHASE. think the amount named is rather small to make such a set of experiments as I should like to see made; and I agree with the Secretary, that it should come out of the departments, and not out of the Association. A subscription of $5 from the departments would cover the bill. I should be ready to respond for the place I represent, and I should prefer to see the money raised in that way, and we keep the balance we have in the treasury, so we can have a little money ahead.

Mr. JOY. I myself had rather see the money raised by subscription, but I made the motion in order to get an expression of the feelings of the members. I suppose that $100 would be but a drop in the bucket of the amount required to pay for these experiments, if the committre should undertake them. As I said before, I am willing to contribute personally.

Mr. BILLINGS. I would ask Mr. Joy to amend his motion so it might be left something like this: That the executive committee should have authority to furnish this examining committee such funds as the executive committee may think wise and prudent to expend from the treasury.

Mr. JOY. Not to exceed $100.

Mr. BILLINGS. I would leave it entirely with the committee. Let the executive committee raise it any way it chooses, and then give the executive committee power to make up what is needed.

Mr. CHASE. I think the committee that does the testing ought not to raise the money. It will have enough to do without that.

Mr. JERRICKS. There is considerable competition among the pipe manufacturers, as you know (laughter), and I have no doubt the different manufacturers of cast-iron pipe would be willing to contribute liberally towards making these tests.

Mr. JOY. I don't wish to take up all the time, but we must remember that the manufacturers have made a scale of rates to sell. The more weight they can get into a pipe, the more profit they can get out of it; because it costs but little more, comparatively speaking, to manufacture a large pipe than a small pipe. If this Association should investigate the matter and conclude that we could use pipe 10 or 15 or 20 pounds lighter than we are now generally using, the manufacturers are going to be the losers, and we the gainers. They may put on a higher price in proportion to the weight, and, as you all know, the lighter the pipe we buy, at the present moment, the higher the proportionate price we have to pay. I think the Association should not figure much on the assistance of the manufacturers. If the manufacturers are very courteous, they will allow us the use of their appa-

ratus, as Mr. Wood's representative here has tendered us the use of his, which I think is very kind in him. But when it comes to asking them to allow us to make the tests, they paying the bills, I think it is rubbing it in a little too hard. I had rather we would be in an independent position, and pay our bills, and not be under the slightest obligation to any manufacturer, other than for the use of his apparatus.

Mr. Joy accepted Mr. Billings's amendment, that the executive committee be authorized to furnish such money as it saw fit for the use of the examining committee, and the Association so voted.

The second topic upon the programme was as follows: "The necessity for use of tank for supplying water closets, hot water boilers, etc." The opening paper was by William R. Billings, Esq., Superintendent of the Water Works of Taunton, Mass., as follows: —

THE NECESSITY FOR USE OF TANK IN SUPPLYING WATER CLOSETS AND HOT WATER BOILERS.

Mr. President and Gentlemen:—

A water closet is a fixture whose duty is two-fold, first to receive at intervals depositions of filth, and second to remove such deposit promptly and so thoroughly as to leave no indication of foulness either to sight or smell. The first duty is passive, and calls for suitable material and form in the bowl; the second duty is active, and as the name of the fixture indicates is performed through the agency of water, and this water should be delivered to the fixture by means of a special flushing tank or cistern. The facts and arguments which support this proposition may be grouped under two heads, viz., Sanitary and Economical. For sanitary reasons each deposit of filth must be promptly and completely removed,

and this removal is best accomplished by a sudden dash of water, which by its momentum shall carry everything before it.

Every good water closet has in its arrangement some form of trap, and the supply of water to do its most effective work must be delivered so as to completely displace at each use of the fixture the foul contents of the trap by clean water. The water should also be delivered to the fixture so as to produce the maximum scouring effect upon the bowl, and this demand, though less dependent than the one first named upon the use of a tank, is not to be overlooked.

Before going further let us make one admission. It is quite within the bounds of possibility so to locate and fit up a water closet to be supplied with water directly from the main that it shall fulfill all the requirements of prompt and thorough flushing. But as a matter of fact the conditions necessary to secure perfect working under a direct supply are so difficult to obtain and maintain, that they are in practice never fulfilled.

In water closets of the hopper and washout types the trap and bowl contain under ordinary circumstances from 1-2 to 1 1-2 gallons. I have found by experiment that with a properly proportioned tank and suitable connections, a fixed quantity, say 2 1-2 gallons, is delivered from the tank through a short piece of 1 1-4 inch pipe to the bowl and trap in about 7 1-2 seconds, or at the rate of 20 gallons per minute.

What conditions must exist to obtain an equivalent flush through a direct supply pipe?

In the average building the service pipe rarely exceeds 3-4 inch in diameter and is oftener but 1-2 inch.

Water closets are seldom nearer the main than 50 feet, and are generally placed at from two to four times that dis-

tance, so that friction becomes an important factor in the problem. I have found by experiment that under a pressure of 55 lbs. per square inch or 127 feet head there will be discharged through

61 feet of straight 3-4 pipe 30 gallons per minute.
122 " " " " 22.5 " " "
162 " " " " 18.75 " " "
244 " " " " 15.75 " " "

These figures are in substantial agreement with those given by Mr. Tubbs, of Rochester, N. Y., and Mr. William Rotch, formerly of Fall River, in their published tables, and may be accepted as not far from the truth. From these figures and tables the following conclusions can be drawn:

To secure for a water closet through a 3-4-inch direct supply pipe, a flush equal to a good tank flush, there must be at the main pipe when the closet is 50 feet therefrom, a pressure of not less than 26.8 lbs. or 62.5 feet head; when it is 100 feet distant, 53.75 lbs. or 125 feet head; when 150 feet distant, 80.4 lbs. or 187 feet head; and with 200 feet of 3-4 supply pipe there must be an initial pressure of 107.5 lbs. or 250 feet head. Even the lowest of these pressures cannot be maintained, constantly and certainly, above the first floor of ordinary buildings in many cities and towns.

These figures do not overstate the case, for no allowance has been made for rusty pipes, numerous tees and elbows and a small delivery cock.

The facts which lie at the bottom of the necessity for the use of tanks in connection with water closets are, first, that property owners from motives of economy and from ignorance of hydraulic laws will not put into their buildings distributing pipes of sufficient size; second, the enormous waste of water in nearly every city, which so reduces the head or pressure on the mains, that even house pipes of generous size are of

little avail; and third, the fact long ago established, that a large proportion of this very waste is caused by water closets directly supplied.

Let me illustrate some of the foregoing statements by an actual example. In a second story office in this city the gauge shows an ordinary static water pressure of 40 lbs.; equivalent to a head of 92.4 feet.

The opening of a single water closet valve near the gauge reduces the pressure to zero, and the flush is almost worthless, and if a second closet valve be opened the supply to each is a mere dribble. There are four closets and four set bowls on the same floor with the gauge, with a smaller number of fixtures on the floors above and below. Such a job of piping is shameful, but is not uncommon.

The danger that under such conditions the foul air of the closet may be drawn into the pipes, to be absorbed by the returning water when the valves are closed, is too obvious to make extended illustration necessary. A single example will suffice. In the seventh report of the Massachusetts State Board of Health, Mr. Edward S. Philbrick writes: "In the supplementary report of the medical officer of the Privy Council for 1874, there is an interesting report from Dr. Buchanan upon an outbreak of anteric fever in Cains College, Cambridge, where fifteen students were attacked while living in a building which was supposed to be provided with the most perfectly arranged sanitary appliances. After a most painstaking investigation the fever was traced, by convincing evidence, to the use of a water closet with direct supply from the mains which had poisoned the water used for drinking in precisely the manner indicated above."

The generous, displacing, dashing flush which a water closet should receive can only be had under ordinary conditions of pressure and piping by the use of a tank. Makers

of water closets have tried to meet the objections which are raised against tanks, of being noisy and expensive, by offering closets in which a large supply of water is held in the bowl or in a tank built on to the bowl. Such closets may secure an admirable flush, but they are not equal to the hopper and washout closets properly flushed from a tank, because of great liability to leakage and a certainty that the valve and other working parts will become foul. The use of a tank puts every piece of mechanism out of the reach of filth, allowing the working parts to be touched by nothing but clean water, and so permits the use of a closet which is perfectly simple and efficient, entailing the minimum expense for repairs or loss of water by leakage.

But to this Association perhaps the strongest reason for the use of a tank is found in the fact that in no better way can the great waste of water through cheap and defective closets be checked. Directly supplied closets are almost certain to be foul and full of bad odors, and as a supposed cure for this, the valve handle is propped up, producing a continuous flow and an almost criminal waste. For a very complete presentation of evidence upon this point you are referred to a little book just issued by Henry C. Meyer of the Sanitary Engineer, entitled "Water Waste Prevention." In this volume, a former city engineer of Boston, Mr. Joseph P. Davis, is quoted as saying: "A very large percentage of the entire waste (which in many cities is at least fifty per cent. of the whole water supply) is due to the use of valve closets," and the chief engineer of the Glasgow Water Works, Mr. James M. Gale, says that an experience of twenty years has strengthened his conviction that a municipal regulation which requires all new water closets to be supplied with water through a special tank is a just and proper one, and he gives six reasons for this conviction, drawn from his experience of twenty years.

The engineer in charge of the Liverpool Water Works, Mr. Joseph Parry, says that instances have come under his notice in which the consumption of water has been reduced from 60 gallons to 3 gallons per head per day, by simply improving the character of the water closet and urinal flushing arrangements, and Prof. Henry Robinson, of London, testifies that one of the most fruitful causes of waste of water has been found to arise from the direct flushing of closets from the water pipes.

The necessity for the use of a tank in connection with a hot water boiler rests mainly upon the uncertainty of direct supply and the need of a reserve to maintain a full boiler when the street supply is for any reason cut off. It is wiser, in this case, perhaps, to say that it is better practice to use a tank than to insist that a tank is, in all cases, a necessity. In fact the writer is not prepared to maintain that a tank in connection with a hot water boiler may not frequently be dispensed with, because so many cases of satisfactory operation without a tank have come under his notice. In any case, however, the question is one of mechanics rather than of sanitation, and a full discussion of it will not now be attempted.

The PRESIDENT. You will excuse me for speaking first. I beg leave to differ from Mr. Billings in the closing point of his paper, and that is as to the necessity of a tank for a hot water boiler. It may not be necessary as a sanitary matter, but I think it is necessary as a matter of safety. Three cases have come to our notice in this city the past year where a sufficient quantity of steam was generated in the boiler to force the water back far enough to destroy the pockets of the meter. Very probably if there had been a pressure gauge on that boiler, and the people had known there was such a steam pressure there, they would not have dared to stay in the

house. If they had kept up the fire long enough to have forced out a large portion of the water, and then a faucet suddenly opened had allowed the street pressure to return, the boiler would have been pretty likely to have collapsed. As a matter of safety I think it is absolutely necessary that a tank should be put on a hot water boiler. I hope this subject will be thoroughly discussed.

Mr. COGGESHALL. I was very much interested in Mr. Billings' paper, and especially with reference to what he said about the volume of the service supply. I think we have all seen instances on our works, like the case of the block he cited in Taunton, where the flushing of the closets reduced the pressure to zero and cut off the supply, for the time being, from the other fixtures. My experience has been somewhat as follows: A man proposes to build a house, and he comes to the office and wants a very liberal sized service pipe. If the house is located on very high ground, and the pressure is apt to be reduced to a very low point, we allow him an inch service. His plumbing may be included in the carpenter's contract. He knows nothing about it and nobody cares anything about it as long as it is done cheap, and in such cases it is generally done pretty cheap. It is the business of the contractor to make all the money he can out of the job, so he hitches on to the end of an inch service with a 5-8 inch pipe, and he furnishes the cheapest kind of a water closet. Very soon we get a complaint that no water can be obtained on the second floor. We send an inspector around to investigate, and he will find that the water closet valve on the first floor is propped up. Well, the pipe above the first floor is of course, filled with foul air that has been drawn into it, as, in the case at Cains College, which Mr. Billings cited, and the proprietor is surprised to find he has only a 5-8 inch pipe in the house, when he supposed it would be the same size as it

was outside. Now suppose he had had only a 5 8 service pipe, and an honest contractor had contracted for the very best of materials, and a good tank closet, such a pipe, as we all know, would have given him an ample supply under all conditions. The question arises; Ought not the water works to have some redress in such a case as this? Ought not something to be done to compel a man, who is so woefully ignorant of the laws of plumbing, to have something done to prevent this enormous waste?

In our town we calculate for an ordinary service to supply, inside of the walls of a house, from thirteen to fifteen gallons per minute. My predecessor, Mr. Sherman, made some very elaborate experiments on that point. It was his custom, for something over a year, to have a meter attached on every service that was laid in the city, so as to find out just exactly how much water went through that service, and the result showed that we generally delivered from thirteen to fifteen gallons a minute. Mr. Billings has demonstrated that this is not enough for the proper supply of two or more valve closets, and he is right; but the flow of such a service would be more than ample for the supply of several cistern closets. Sometimes the mains are reversed. They will be shut off very quickly for some cause, or the mills will draw large volumes of water (they do down our way, although when they come to settle up you wouldn't think they had used any water at all), and this leaves a scanty supply for the high elevations in the city. One evening not long since I sent out some men to open some blow-off gates. Pretty soon the neighbors came to my house with the report that they could not obtain any water. In my own house, which is fitted with tank closets and a cistern for the boiler, we were not troubled at all and knew nothing about it. The boiler in the house of one of my neighbors entirely collapsed, as in the case the President cited.

In the year 1882 several articles appeared in the Sanitary Engineer, in which this subject was considered under the head of waste water. The New York Health Department at that time required all water closets to be supplied from cisterns. The manufacturers of valve closets made a protest against this, thinking it was a hardship, and endeavored to have the rule modified so as to allow the supply of valve closets direct from the main, providing there was a check-valve on the supply pipe. Among the articles in the paper to which I have referred, all of which were very interesting, was one written by Mr. Philbrick, and he, as were other high authorities, was very decidedly in favor of the cistern closet.

Not long ago a gentleman built a tenement house in New Bedford, in which there were, perhaps, half a dozen water closets. The work was done by contract. He is a man who likes to figure the cost down pretty close, and he got an idea into his head that if he had a meter put on, the cost of his water would be considerably reduced. A meter was put on. Several times our inspector went there and always found some of the valves leaking, and some of them leaking pretty badly. He reported the fact to the owner several times, but the owner didn't think it worth while to pay much attention to it. Well, at the end of the year, Mr. Hathaway had a bill against him for $60 over and above what the regular water rates would have been. [Laughter.] Of course he was going to have the meter taken right off; but it was the Water Department's turn then, and he was told, "No sir." [Laughter.]

Mr. RICHARDS. I entirely agree with the President in what he said about the importance of supplying kitchen boilers from tanks. I think it is the safest, surest and most satisfactory way. I would go further. I would say

that to supply from a tank is the most satisfactory way anywhere, except, perhaps, where the only draught is for a kitchen sink. In any ordinary residence, where there is a bath tub and water closet and the usual fixtures, the most satisfactory way, and I think the cheapest, too, is to supply from a tank. There is a saving in the plumbing, in the weight of the pipes, and there is a considerable saving in the size of the service pipe. I have in mind a building containing seven apartments, with bath tubs, water closets and kitchen sinks, 16 water closets and numerous faucets, all of which are supplied through an inch tap and tanks. Now, I do not believe you could supply three water closets through an inch tap without a tank. It would be necessary to have a very much larger service. As to boilers, there is a boiler made that will resist collapse, but I have known such a boiler to be burst by over-pressure; and you are liable to have over-pressure if you do not have a tank. It is necessary with all of us to shut off, once in a while, and in such cases there needs to be a supply fo the boiler. I know of one case where they try to empty the boiler by putting on a check valve, and two Brown seamless boilers were burst, proving that they won't work any more than the other kind.

Mr. CHASE. Some rather amusing episodes of the same sort have come under my observation. Soon after we started supplying water, a plug, of sufficient size to take off the pressure, blew out. The next day the treasurer of our Water Company came into the office and said they had had a very exciting time up at his house. He had a number of colored servants, who were very superstitious set, and they thought the Devil had surely got possession of the kitchen (laughter), for the boiler had collapsed. It immediately occurred to me what the trouble was, but I have never enlightened him in regard to it. I may mention here that many of the houses

in the city had been previously supplied by tanks, which were filled with water either direct from the roof, or, when that supply failed, by water raised by a force pump from a cistern. When they connected with the city water, they considered the tanks as of no use, and, I suppose, thinking the advice I gave them was of no value because it didn't cost them anything, they took the tanks out. In another case a meter was taken out, and I noticed that the rubber gears were all broken. Investigation showed me that the boiler had been run under such pressure that the hot water had gone back from the boiler into the main, and I don't know how much further. We notified the people at the house that we didn't want to be blown up at our works (laughter), or we didn't want to furnish steam to our customers (laughter.)

We have had three boilers collapse in our city. In fact, a collapse does not describe it. The boilers were shrivelled up like a sucked orange. A good many people, to avoid such accidents, have adopted the use of galvanized boilers. They consider that tanks and vacuum valves are the device of the adversary, and so they are putting in something which they think will stand.

We had an application the other day to supply a large boarding house, or a sort of a hotel. The local builder showed me a plan of the second story, which he said had been sent to the owner in New York, and had come back approved. The house had 40 rooms, 20 on a floor, with stores underneath, and they had provided on that one floor 16 water closets and 18 bath tubs (laughter). He said the next floor was to be supplied in the same way, and they wanted a four-inch service pipe (laughter). He says: "You know more about the matter than I do, "—I should hope I did! (laughter),—" I should like to have you give me a little

advice, for the owner is sort of looking to me to have things fixed up right." I told him that as a matter of neighborly friendship I should be very glad to help him out all I could, but it struck me that the owner of the property could well afford to pay for advice, and I convinced him that he had better "go slow" until he had consulted with the owner. Subsequently I had a little talk with the proprietor, and I told him I thought I could save him some money and earn some for myself. He could not see at first how I was going to get any money and save him any. But when I showed him that there would be about $2000 worth of plumbing, I showed him I had saved him considerable money already. The result was, the building will have four bath tubs and seven water closets, and some bowls distributed about; and, instead of a four-inch pipe we are going to put in a three-quarter inch pipe with tanks. The plumbing will all be first class. I think, under the circumstances, I ought to have a little percentage on what I saved him, not on what the work is going to cost him.

Mr. NOYES. One point, I think, has hardly been touched upon with sufficient emphasis, and that is, the sanitary importance of the use of a tank for water closets. In making extensions, as we probably all know, we frequently have to empty a line of pipe. That immediately causes a vacuum, and if any of the fixtures in a building are open, there is a draught into the outlet of these fixtures, which at times is very strong. If, at such a time, a valve closet is used, some of the foul matter is very liable to be carried into the pipe by the suction. I have in mind two or three cases which have come under my observation. We were working on the street main one day, and a man came running to me and said his meter was acting very strangely, and he didn't know what the matter was with it, and he wanted me to go and see. We

were making an extension of a 20-inch main, and quite a long section had to be shut off. We had given notice that the water supply would be shut off at such a time, and for the people to have water enough in their tanks. The people in this house supposed they should open all their faucets, which they did, and the result was that the meter was unwinding at a furious rate. [Laughter].

In another case we had this experience. Our supply is direct and indirect. Our force main is our supply main. Two mains lead from the station; one is a 20-inch into the reservoir, and the other is a 20-inch, reducing to 16, and runs to the north-west part of the city. On an elevation off that main, we had considerable difficulty, when shutting down our pump, with a heavy water-hammer, which we were not able to overcome, except by the placing of an air valve, by which we have prevented the water-hammer, but not the fluctuation of the water in the pipe. Being called to examine that, in connection with our superintendent, I requested him to make some tests as to what the fluctuation was. He put a pressure gauge upon the pipe, and noted the time when we shut down pumping. He found, when the normal pressure was 25 pounds at the pump, the pressure gauge dropped to nothing, and not having a vacuum gauge, we were unable to tell the amount of vacuum. But the pressure immediately oscillated back to 6 and 5-10 pounds, and oscillated back and forth until the pressure guage came to rest. Further experiment showed, by the opening of a faucet, that there was a fluctuation, so that there was a very considerable suction for quite a length of time. Had a water closet, connected directly with the supply, been used at such a time, the draught would undoubtedly have been liable to have sucked foul matter into the pipe.

This appears to me to be of great importance; and, in designing our plumbing rules for the Board of Health, some two years ago, we laid it down as a very strong point that no water closet should be connected directly with the water supply. That met with a good deal of opposition on the part of the plumbers, but wherever it can be insisted upon within reason, we will not allow the connection to be made.

I agree with the President, also, as to the importance of a tank for hot water boilers, and a large and liberal tank, because of the liability of the supply being intermittent. In New York and in Boston, and many of the large cities, (and it is becoming true very fast in many of the smaller places, on account of the small size of the mains,) when the consumption is large, there is little or no flow of water in the high buildings; and, in a great many cases, during a considerable portion of the day, no water will run into the tanks. A tank should be large enough to supply the boiler for at least a day. This necessity will become more apparent, in a very large number of the works, on account of the small piping. The same necessity would, of course, apply with regard to water closets, for, should the closet be used, even though there were no suction, without a sufficient flow of water, it would become foul and offensive during the hours when there was no flush. It seems to me a tank is of the utmost importance, as a sanitary measure, in connection with water closets, and, as a matter of safety, in connection with hot water boilers.

Mr. HEALD. I have had an experience in my own house which would be amusing were it not serious. It was really serious because in one case the boiler burst and in the other case we had to send for a plumber. (Laughter.) The water was shut off one Sunday morning, and we were not notified. There was a hot fire in the kitchen stove, and the first thing

they knew of any trouble, the boiler began to jump. First it sat on the floor and then on the ceiling. They went down stairs to shut off the water and the meter was so hot they could hardly put their hands on it, and it was running backwards so fast that I hoped I could get a rebate on the water, but I couldn't. [Laughter.] They sent for a plumber to come up and he didn't know what to do, really. They drew the fire from the stove and finally got the boiler uncoupled, and then it was all right. Of course, if there had been a tank there would not have been any trouble. In the other case, I think the water must have frozen in the pipe below. I was not at home at either time and I was glad of it, for when I got back I could tell them what they ought to have done. [Laughter.] It was a good deal easier to tell them then what they ought to have done, than it would have been to have told them what to do at the time. [Laughter.] This second time, they built a fire in the kitchen stove and it worked nicely for a time. The fire started all right, and pretty soon the boiler started. [Laughter.] It burst up in the bath-room and flooded the room pretty well. I think it was a Brown Bros. seamless boiler, and I had another one put in, but we haven't got a tank as yet. Quite often, in the upstairs tenement, if they are drawing water down stairs, there will be a thumping in the boiler, there is so much pressure, and when the thumping troubles them any they shut off the supply and open the faucet in the bath-tub, which operates as the spout of a teakettle. [Laughter.]

Mr. BILLINGS. I knew Mr. Heald in school fifteen years ago, and I recognize his style. [Laughter.] I am glad I stirred up such a hornet's nest about hot water boilers, for I wanted to bring out the opinions of the members. I am sometimes called upon to give advice as to the best method of arranging sanitary appliances in a house, and I have found

several cases where not only the plumbers but the owners objected to putting in a tank. They thought it was a nuisance and they didn't want it. I have been pressed, in at least one case, to have the direct pressure put on the boiler, but I was careful to tell them that if they ever received a notification from the Water Department that the supply was to be shut off, they must draw the fire; and I cautioned them, also, in a general way, about the danger. I do not believe I shall be willing, hereafter, to give even that qualified assent.

Mr. HEALD. I should hardly think there was need of drawing the fire if the service supply is shut off and the faucet open. I know our folks run a very hot fire that way, and have no trouble at all. Occasionally steam will come out of the faucet, but there will be no trouble.

Mr. BILLINGS. I imagine the servant girl is more familiar with the fire in the kitchen than with the shut-off in the cellar.

Mr. JOY. I am reminded of a little experience I had with a tank in our town. The water was turned on to a house, and I arranged the ball-stop in the tank. The gentleman was up there when I arranged it in the first place, and saw me adjust it. He thought it didn't run fast enough, or something, so he went to work to readjust it, so it would run faster. Then he went away and in a few minutes the servant called him and told him the tank was running over. He ran up stairs, rushed into one of the rooms and grabbed a pitcher, and began to bail the water out of the tank and to carry it and throw it out of the window (laughter) and sent the servant off after me. When I got there the water was running over the top of the tank and he was still bailing it and throwing it out of the window. That man represented, as a Senator in the Massachusetts Senate, one of the districts of the County of Worcester. [Laughter.]

Mr. COGGESHALL. About a year ago we had our boiler connected, where the normal pressure on the mains must have been at least 45 pounds. The boiler was situated in the bath room, right over the dining room. It had a common check-valve over the top of the syphon, where it came into the boiler. The best of care had always been taken of the boiler, but the check-valve must certainly have failed to operate sometime, and must have collapsed when I knew nothing of it. One Sunday afternoon we had the dinner all laid on the table, ready to serve, when down came a volume of water a good deal larger than we needed for the time being, (laughter), and we had a pretty wet dining room for the next week.

Mr. CHASE. I am fully in accord with the gentlemen who have spoken as to the necessity of having a tank both for water closets and hot water boilers. We have to temporize a little on account of the penuriousness of the parties owning the property. I think the plumbers would be very glad to do the work at the prices they charge. [Laughter.] While we cannot insist that a tank should be provided, I think we might insist upon the attachment of a safety-valve, which is done, as a rule, and also a vacuum valve. And then, while I don't approve of the practice, I don't see why a boiler should ever burst or collapse, providing both fixtures are kept in the proper condition.

Mr. HEALD. I had a vacuum valve on the boiler in my house at the time they shut off, but the two valves were not sufficient for the draught on the pipe.

The PRESIDENT. I believe the penuriousness brother Chase speaks of is not a factor confined to North Carolina, but it is one of the worst factors we have to meet with here in this matter of tanks for closets. Another matter, not so directly affecting water works, except as it affects the tank question, is the practice, in this cold climate, which, of course,

is not so common in the South, of putting water closets into old buildings and setting them down cellar to get them out of the way, because there is no other convenient place to put them, and then not having a tank. It should be a rule of all Boards of Health, I think, not to allow a water closet to be set in a cellar. That is one of the things, however, which we have not been able to prevent in this city, and I presume the same difficulty is met with in other places.

Mr. COGGESHALL. A friend of mine, building in New York, was only allowed, I think, a 3-8 tap, and he was not able to obtain any water at all on the third floor. After consulting with the plumber, he connected right on to that 3-8 tap with an inch-and-a-half tap, and ran that right up to the top of the house, taking off for the kitchen a half-inch pipe. After that he had no trouble in getting a supply on the third floor. I think that shows it is well to maintain a large main right through the house and to take off smaller branches.

Mr. RUSSELL. I have had some experience, within the last two months, in a house on Allston street, with a 40-gallon copper boiler, which was connected directly on to the main, one of Hicks & Badger's best make. They got up such a fire in the range it burst the boiler. They carried it to the boiler shop and had it repaired, and put it back, and inside of a week it burst again. Then they put on a galvanized iron boiler, and ran the fire so hard in the range it forced the hot water back into the street main, forced the water completely out of the boiler, so it burnt the water-back out, and they had to put in a new water-back. Two weeks after that time, they forced the water out again, and burnt the pipe off between the water-back and the stove. All this happened within one month, and the landlord wouldn't have a tank in his house. (Laughter).

Mr. BABCOCK. It seems to me a common check valve in the pipe would prevent the water running back into the main. Wherever a hot water boiler is used we compel them to put on a check valve.

Mr. RUSSELL. The steam blew the water back into the main in the case I speak of. I would ask the last speaker if he thinks a check valve would do any good when the pressure is as high as that.

Mr. BABCOCK. I understand the gentleman now. I mean to say that no water will run back into the pipe, when the water is shut off, if there is a common check valve.

Mr. CHASE. We have an arrangement with the city authorities to flush the gutters during the summer season, and a large amount of water is used, so that in certain portions of the city there is a vacuum for quite a length of time. Some of the consumers seemed to be very willing the meters should run backwards, and as a matter of self-protection, in order to get any money, we were obliged to put in check valves.

On motion of Mr. Hall, the Convention then voted to take a recess till half-past seven o'clock.

EVENING SESSION.

The evening session was called to order, pursuant to adjournment, by President Ellis.

ELECTION OF OFFICERS.

The first business was the report of the committee on nominations. Mr. Horan, for the committee, reported as follows:

President, R. C. P. Coggeshall of New Bedford; vice-presidents, W. B. Sherman of Providence, R. I.; W. R. Billings

of Taunton; S. E. Grannis of New Haven, Ct., and F. H. Parker of Burlington, Vt.; secretary, A. S. Glover of Newton; treasurer, Edwin Darling of Pawtucket, R. I.; executive committee, Geo. A. Ellis of Springfield, W. H. Richards of New London, Ct., and F. E. Hall of Quincy; finance committee, G. E. Batchelder of Worcester, N. I. Jordan of Auburn, Maine, and W. H. Harding of Cambridge.

The report was accepted, and, on motion of Mr. Brown, the secretary was instructed to cast the ballot of the association for the candidates reported by the committee. The secretary attended to the duty, and the President declared the gentlemen named to be elected.

FLUSHING STREET MAINS.

The first paper upon the programme of the evening session was: "The necessity and method of flushing street mains." The opening paper was by J. Henry Brown, Esq., Supt. of the Mystic Division of the Boston Water Works.

THE NECESSITY AND METHOD OF FLUSHING STREET MAINS.

Mr. President and Gentlemen:—

I think there is no doubt in the minds of water works people of the necessity of flushing the pipes which furnish us with water. How great the need, and how often, depends upon the water we use, as some supplies carry more mud and eels than others. The dirtier ones need flushing oftener. I think we all find that on long mains, where the houses are scattered and the consumption small, there is more complaint of poor water and more trouble from eels. Now the only way, when these complaints come, is to go and blow off that section. We find in our department that flushing twice

a year, late in the spring and fall, will keep our pipes clean, excepting the dead ends, which we blow off once a month. It also makes a great difference whether our cities and towns have a system of sewerage. Now where there is no such system we are dependent upon the streams in which to enter blow-offs, and consequently they cannot be placed as often as necessary. Then the only way is by using the hydrants. While partially answering the purpose, such a method does not clean the pipes so thoroughly as a blow-off branch of the same size as the pipe. I find that opening and closing the hydrants on the section, before blowing off, helps the flushing, as the working of the hydrants thoroughly stirs the water in the pipes, and then the blow-off carries it out clean. I think that if more attention was paid to laying our water pipes to a grade, and to placing a blow-off wherever there was a low spot, it would be of benefit to the works. The only objection to placing a large number of blow-off gates is the expense, but that will be more than balanced in the amount saved in labor in making alterations and connections.

Mr. HANCOCK. As Mr. Brown tells us, I think there is no difference of opinion as to the necessity of flushing street mains. But it seems to me that there is a proper way to flush them, and I will tell you the way we flush the mains in Springfield. The main leading to our reservoir is something like eleven miles long. We find, in order to make a successful flush, we must commence at the upper end, at the reservoir. At all the low points we have 8-inch flush gates, branches taken from the bottom of the pipe. By opening an 8-inch valve we get a rapid current which stirs up the sediment, not only the vegetable but the animal, and all other matter that is in the pipe. We continue along down the line until we get into the city. When we get here we open the lowest point and take out what we term the bottom. We

open so large a stream that we reduce the pressure to nothing on our high levels. In other words, we open it so we get a pressure, at this level where we are, of about 40 pounds. Our pressure, without this open, is 120 or 125. That is the way we flush what we term our high service.

Now, we have another system, the low service, where we carry 40 pounds pressure. The way we manage in flushing that, that is, the way I manage it, and I have found by experience that it gives the best result, is this: we go on to a point perhaps 50 feet below where we are, and open the flush gates there first, and we leave them open. Then we come to this level where we are, and open a 6 or 8-inch gate into the sewer. That reduces the pressure from 40 pounds down to 10 pounds. Then we go up to a point within half a mile of the reservoir and we open a 12-inch gate from a 20-inch pipe. That takes the pressure entirely away. We can't draw water, at this point, on the first floor. We let it run a sufficient time to empty the pipes from that point to the reservoir, and then we close that gate. Our gates below are open, and we leave them open, and go to a point still further south and open other gates there. The idea is to give the thing a good stirring up and to get it all started. Then, by leaving the valves open at the high points we find that the air has a chance to escape. There is no danger of breaking our cement pipe, it stands the pressure all right. The last gates that we close are those at the highest points.

Of course, every system of water supply has its peculiarities. The simple point with us is to give the interior of the pipes a thorough shaking up, to take the bottom right out; and we find it has a very good effect upon the water. If we do not do it the sediment in the bottom of the pipe impregnates the water very perceptibly. We believe in the necessity of giving the pipes a thorough flushing. All water con-

tains more or less vegetable matter. A good many of us undoubtedly remember the time when we used to drink water from "The Old Oaken Bucket Which Hung in the Well," and how we had to wash out the bucket occasionally, for there would be a gathering of vegetable matter upon it. That same sort of substance gathers in water pipes, I don't care how pure the the water is. Of course the more vegetable matter there is in the reservoir, the greater the necessity of flushing the pipes. Although having a new reservoir, we find it absolutely necessary to do it.

Mr. SCHLEITER. The necessity of flushing mains is recognized by us all. We may differ as to method, but I think Mr. Brown set forth in his paper the point that is to be observed in flushing. I think there should be a blow-off of the size of the main wherever there is a low point in the main, not only for flushing the main but for draining off the water for the purpose of making repairs. It should be connected with a sewer or culvert. The flushing of mains through hydrants, I think, is not of very much account unless you have a small main. Usually the hydrants are of small capacity compared with the size of the main. There should be blow-offs in such localities as will enable you to flush the main by sections, as Mr. Hancock has described. We see the necessity of flushing mains several times a year. They should be flushed in the spring, at all events. In all works which depend upon shaded ponds for a supply, the water will ferment in summer, and whenever it ferments and becomes of bad odor, the pipes should be flushed.

Mr. HOLDEN. I have brought a small blue print plan of the gates and pipes throughout the city of Lowell, which I think will help to explain our system of flushing.

When our works were built, many of our streets were laid out so crooked that we were unable to have any regular

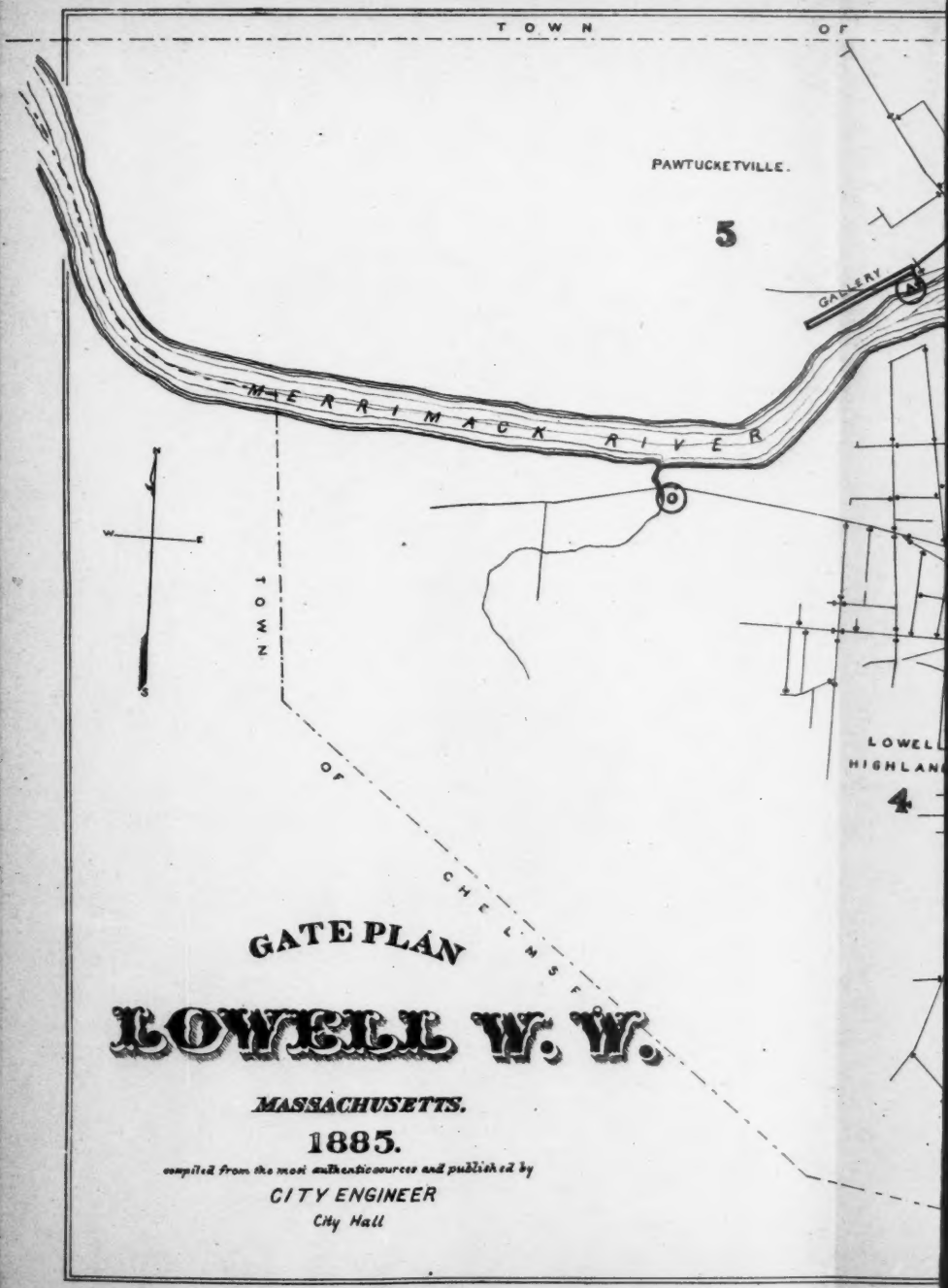
system of placing gates. Consequently, in many localities, when we wish to shut off a line we have to close from ten to fifteen gates, while in others two or three gates are sufficient. I have plans of the gates similar to this one put into cheap frames, which I give to all the regular hands on the work, so that if anything happens when I am away, they will know which gates to shut off.

This plan shows the location of our works. A is where the water is taken from Merrimack river, a short distance above the falls, partly from a gallery and the balance from the river. It is about two miles from there to the pumping station, B, where the water is forced into the reservoir, C. From the gallery to the pumping station about 4200 feet of the conduit is brick, and the remainder is a thirty-inch pipe.

As the water in the river at certain seasons of the year carries considerable silt, much of it lodges in the conduit and pipes.

A thirty-inch main leads from the reservoir and crosses the Merrimack river at D. After reaching the highlands of Belvidere it is distributed in one direction through a 24-inch main which runs through the central part of the city, while the southerly part of the city is fed by a 16-inch main. These mains gradually reduce and branch off to 6-inch pipes, which are the smallest pipes we lay.

Now, when we blow off the mains, we start first at the conduit line. There is a 30-inch gate which we shut down at this brook, E, and a 30-inch branch with a gate which we open to let the water out of the conduit into the brook. There is about 30 feet head here, so that we get over 12 pounds' pressure at this place. The water rushes through from the river and cleans out all the silt and whatever foreign substance has lodged in the conduit line.



GATE PLAN

LOWELL W. W.

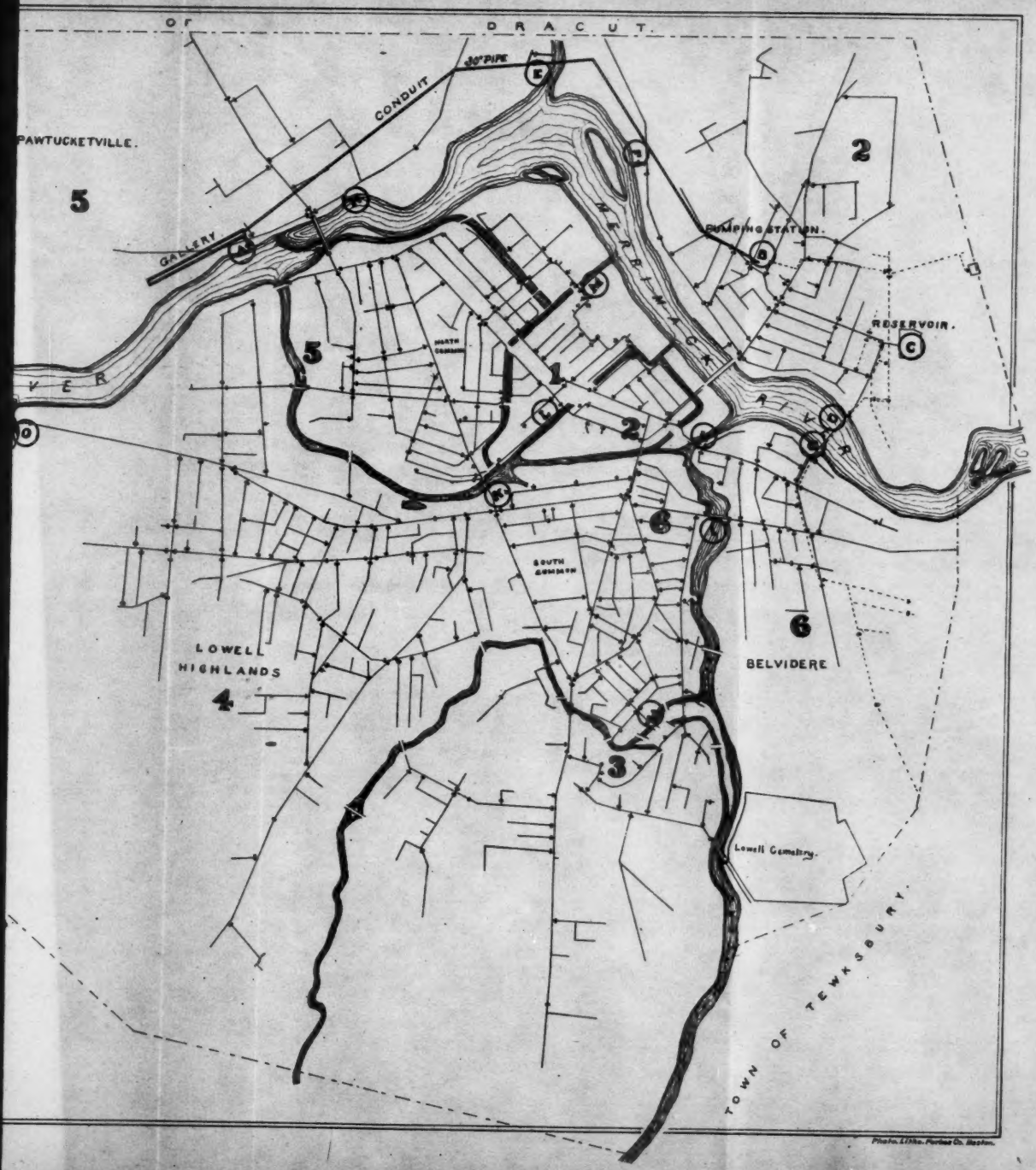
MASSACHUSETTS.

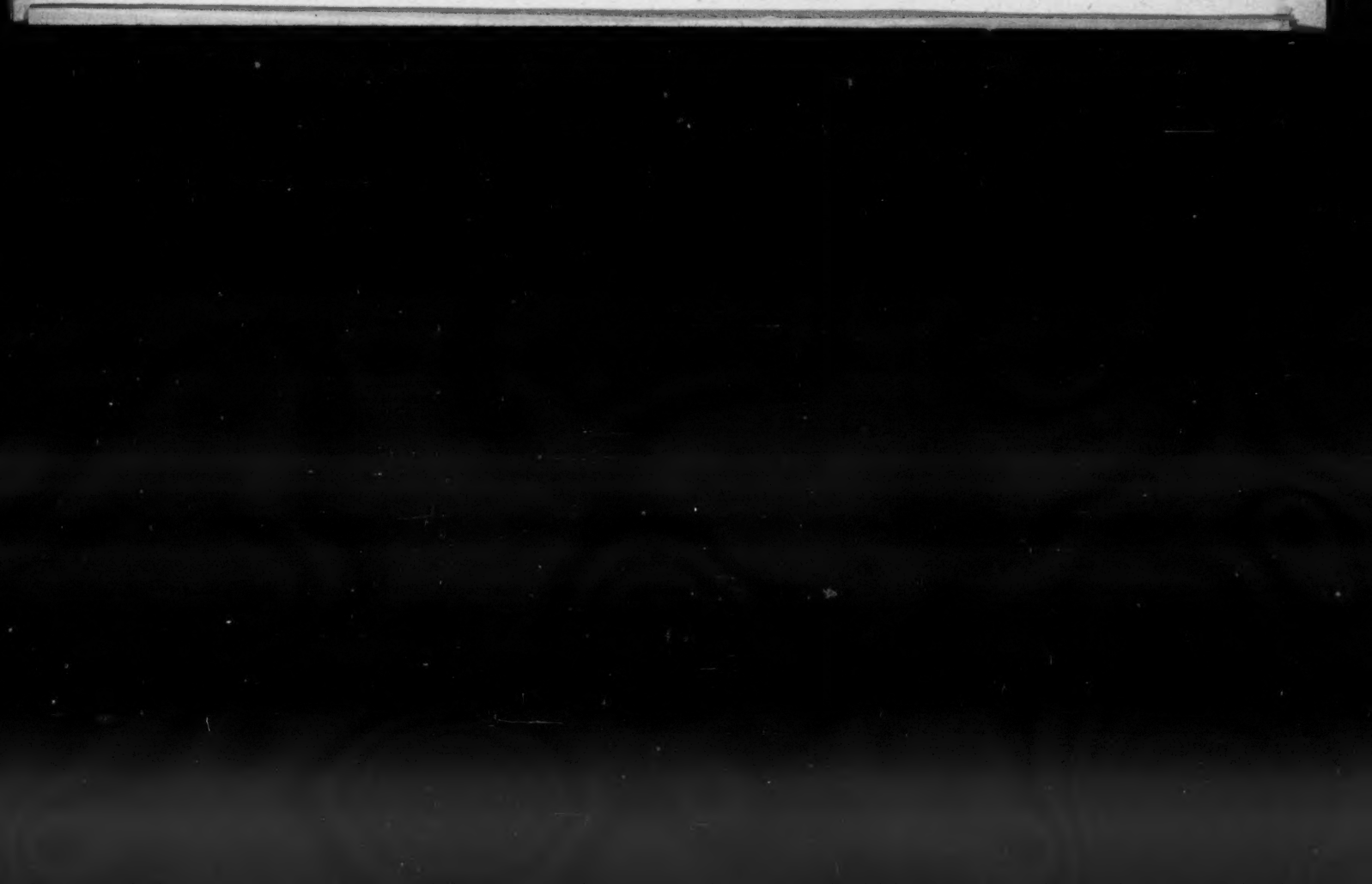
1885.

compiled from the most authentic sources and published by

CITY ENGINEER

City Hall


OF DRACUT.
30" PIPE
CONDUIT
PAWTUCKETVILLE.
5
GALLERY
MERRIMACK RIVER
PUMPING STATION.
2
RESERVOIR.
5
NORTH COMMON
1
2
RIVER
SOUTH COMMON
6
6
LOWELL HIGHLANDS
4
BELVIDERE
3
Lowell Cemetery.
TOWN OF TEWKSBURY.
Photo. Litho. Forbes Co. Boston.



In cleaning out our mains we start from the reservoir, C, on this 30-inch line which crosses the river at D. At the river there is a 20-inch gate, which we open. There is also an 8-inch gate at F, which takes the part of the city north of the river, and by opening this we clean the whole of this locality. The water from these gates runs into the river in plain sight and when it runs clear, if we shut both gates at the same time, and whatever sediment is left in the pipes is carried to the south side of the river and blown out through an 8-inch gate at G, which is opened previous to shutting the former gates.

We next take that part of the city which lies east of the Concord river. I have an 8-inch gate on the 24-inch pipe at H, and an 8-inch gate on the 16-inch pipe at I. We open both these gates at once, and that keeps the clear water in motion, driving the muddy water ahead of it all through this locality into the river from these two blow-offs. As soon as the water here runs clear, and before we shut these gates, I open a 6-inch gate at J, also 8-inch gates on each side of the canal at K, and as soon as these are opened we shut those gates at H and I. Then we open at L and M, and finally at N and O. I keep a man at each gate, so that in case of an alarm of fire they can be shut down as quickly as possible, although we have never had an alarm of fire when we were blowing off. I keep the water in circulation from the time it leaves the reservoir until it reaches the last blow-off. We have hydrants at the extreme ends of all the pipes, which we also open after we have closed all the gates, and in this way all the roily water which remains in the pipes is discharged through the hydrants.

Mr. SHERMAN. Do I understand you that those main blow-offs are kept open all night—the larger ones?

Mr. HOLDEN. No, except these two. We start in the morning, and we get around here about night to these two, this one here and this one up here. We get everything blown off so the water has moved up as far as here, and these two are allowed to run all night. They are 28-inch blow-offs, and by letting them run all night there will be very little sediment left.

Mr. SHERMAN. How do you maintain your pressure when you have your 30-inch gates open?

Mr. HOLDEN. Our 30-inch gate is on our conduit. We are not pumping at the time.

Mr. SHERMAN. I understood you to say you had a 30-inch gate down at the Merrimack river.

Mr. HOLDEN. It is a 20-inch gate there, and the main is 30-inch.

Mr. SHERMAN. Don't that take off the pressure from your 30-inch main?

Mr. HOLDEN. It takes off the pressure at the highest points, and there are quite a number of places where they don't get any water; but we keep them open only about half an hour, and I always put a notice in the papers three days beforehand, that at such a time we are going to blow off the mains, and during that time the water will be roily, and in many places there will be but little pressure. Our plan is to start at the reservoir and follow along to the extreme ends, right through the city.

Mr. NOYES. I should like to ask if the water discharges very roily.

Mr. HOLDEN. Oh, tremendous roily. When we first open it will be almost thick.

Mr. NOYES. Is it rust or mud?

Mr. HOLDEN. Iron rust and silt. I have had it analyzed by different chemists, and they have found no animal

matter in it, and no vegetable matter. They have found nothing, really, except iron rust and some silt. I have had it analyzed from house filters, the Crocker filters, as they call them, where they have let them run a month in the house, and then reversed them. I have taken the sediment and had it analyzed; and all of the chemists who have analyzed it—and I have had half a dozen different ones—say about the same thing,—some iron rust and some silt which comes from the river. Most of the year our river is very clear, coming right from the hills in New Hampshire. Generally for about a month in the spring, however, the river is quite roily, and sometimes it will be roily at other times of the year, if we have a heavy rain. During such times we pump as little as possible. Our reservoir holds about 30,000,000 gallons, which will give us eight days' supply; so, when the river is roily we pump as little as possible.

Mr. NOYES. I should like to ask Mr. Holden if his pipes are all cast iron and all tarred.

Mr. HOLDEN. We have about a mile of wrought-iron pipe, but the rest of it—77 or 78 miles—is cast iron, and it is pretty much all tarred. I should say there are about three miles of 8 and 12-inch pipe, which was laid in 1849,—that would be 36 years ago,—that is not tarred. All that has been laid since our water works were put in, since 1871, has been tarred.

Mr. HOWLAND. What are your service pipes?

Mr. HOLDEN. Our service pipes are tarred wrought iron, but lately we have been putting in lead. I am now putting in more lead than anything else, and I hope eventually to have all of them lead.

Mr. HOWLAND. You spoke of analyzing the residue in the house filters; have you analyzed the residue you get from the main blow-offs?

Mr. HOLDEN. Yes.

Mr. HOWLAND. And does it correspond to what you find in the house filters?

Mr. HOLDEN. It corresponds almost perfectly. There is more silt in the blow-offs than there is in the house filters, and there is, also, more rust.

Mr. HOWLAND. Are you troubled any with your house service pipes clogging up?

Mr. HOLDEN. I should say we were. We have more bother with our house service pipes than with anything else, unless it is with the meters. [Laughter.] I think we have changed more than 100 service pipes this year. We take them out and change them for just about the cost of the pipe and fittings. I am willing to do the building from the main into the house cellar for nothing, if I can be paid for the cost of the pipe and the fittings I put in. When I put in iron pipes, I use nothing less than an inch, and a great many want to have 2-inch put in, but I tell them I can't tap with anything larger than an inch. Our service pipes are filling up incessantly.

Mr. HOWLAND. Have you made any examination of your mains to see where this oxide of iron you get through your blow-offs comes from?

Mr. HOLDEN. Well, we cut into our mains frequently, where we are making connections, and we find but very little rust, very little oxide of iron. In those that have been in 12 or 13 years there will be a little, but nothing to amount to much.

Mr. HOWLAND. In the form of tubercles mostly?

Mr. HOLDEN. Yes, in the form of tubercles, but very slight. They will be about as large as a nickel, in different places.

Mr. HOWLAND. In blowing-off, what velocity do you think you get in your pipes?

Mr. HOLDEN. Most of our blow-offs are situated down on the low lands. We have plenty of rivers and brooks and canals to blow off into. Our pressure is very near 70 pounds, from 60 to 70 pounds. I think we have no blow-off where it would be less than 60, and none where it would be more than 70.

Mr. HOWLAND. And you reduce that pressure to almost nothing at the blow-off?

Mr. HOLDEN. No, not at the blow-off; it would not be reduced to almost nothing, because we get a fair circulation through the city. On the highlands the people generally draw beforehand, but in the main portion of the city there is plenty of water, although it is pretty roily when we are blowing off.

Mr. HOWLAND. You think that by opening these large blow-offs, you increase the velocity to a point which will scour the pipe and clean these tubercles off?

Mr. HOLDEN. The tubercles seem to be loose on the pipe, so they will come off very easy. They don't seem to be fastened on, as they are in some pipes. For several minutes after the water begins to come out it will be of a brownish color, and even after it has run sometime, if you catch it in your hands, you will see it is all full of little black specks.

Mr. HALL. Do I understand Mr. Holden to say he thinks he can wash off the tubercles in the pipe? I would like to ask if he believes he can do that to any great extent.

Mr. HOLDEN. I don't imagine we could wash them off if they were on very fast; but they don't seem to be held on tight to this tarred cast iron pipe. I know, where we have taken out pieces, they will come off of themselves without any scraping. You can brush them right off with your hand.

Mr. HORAN. Are you troubled any with air getting into the mains when you have the large blow-offs open?

Mr. HOLDEN. No air would get in anywhere, unless somebody up on the high points left the faucets open. But the people have got so now they keep their faucets closed through the day, when we are blowing-off, because they are afraid it will draw the rust into their pipes, and they are troubled now so much with their house pipes filling up with rust, that they don't like to get any more in than they can help. So, during the time we blow off, there is very little water used.

Mr. HORAN. If it was used, you think the air would get in at the high points?

Mr. HOLDEN. I don't think a great deal would get in; we never have had any to bother us at all.

Mr. HORAN. If your blow-offs on the high points are as large as your mains, what would there be to hinder the air from getting in, if they were using the water in the lower part of the city?

Mr. HOLDEN. The only way it could get in would be through the house faucets.

Mr. HORAN. If those were opened the air would get in?

Mr. HOLDEN. Certainly. But our mains are very large, most of them 12 and 8-inch, and in some of the outskirts 6-inch; consequently the amount of air which would get in would not cause much trouble. I always have a hydrant on the highest points, everywhere that I can, to let the air out. If we are shutting off a line, we always calculate, when we let the water on, to open a hydrant at the highest point, and that will let all the air out. We have very little trouble with air in the pipes.

Mr. HYDE. The area of the City of Newton is about 20 square miles. We have about 71 miles of main on an area of

14 miles. I blow off my mains once a year, thoroughly, in the winter time. We have no sewers, and so I have to blow off in the winter when the ground is frozen. We close all the gates on one line, and blow that out thoroughly by opening all the hydrants and blow-offs. We also blow off the mains once a month, regularly, by opening the hydrants or blow-offs. I have a 2-inch blow-off. I make a 2-inch tap, put on a 2-inch waste valve, and have a little piece of pipe screwed on to that, and boxed with a cover that comes up to the street surface. Then we can screw on a piece of pipe with a hose connection, and screw the hose on to that, and blow off the best way we can into the fields or gutters. It takes us about eight days in every month to blow off our mains. We have a great many miles of main where there are very few water takers, and, especially in the summer time, when the ground gets warm, we have considerable trouble. If I delay three days over the usual time of blowing off, I hear from it in a great many places.

The SECRETARY. Mr. President: I have received from Mr. Wilbur F. Learned, Resident Engineer of Basin 4, of the Boston Water Works, a very pleasant letter regretting his inability to be present with us to-day, and speaking as follows in regard to flushing street mains:—

"In the water pipe system of the city of Boston, 'blow off' pipes are used for the double purpose of flushing and emptying the pipes in case of alterations or repairs. They are located in the valleys where drainage, either natural or artificial, can be procured, as by a brook or sewer, and at the end of pipes in streets that extend to tide water. Owing to the very irregular arrangement of streets in the city it has been impossible to have a system of blow-off pipes covering regular areas of the pipe distribution, such as could be obtained in cities more recently laid out, as in Chicago, for in-

stance; but they have been located at such places that all the pipes can be flushed, and, by the arrangement of valves, one section of pipes can be flushed independently of the others. The largest size blow-off used in this city is 16-inch diameter, from a 48-inch diameter pipe, and none less than 4-inch diameter, from an 8-inch diameter pipe. In some sections of the suburban district where it is not possible to blow off into a brook or sewer, and at 'dead ends,' the hydrants are used for flushing the pipes. The flushing is done at irregular intervals when complaints have been made of bad taste of the water, or when the flow of water through the service pipes becomes impeded by fish or other causes. Under such circumstances, the blow-off valve is opened nearest the locality from which the complaint is made, observing, however, not to flush the pipes on the days when the consumption is greatest, as, for instance, on Monday, nor during a fire in any part of the city; but usually on Saturday night after the general suspension of business. If an alarm of fire should be struck while flushing is being done, the blow-off valve is closed at once in order not to deprive the fire service of water, a condition that may be fulfilled very easily. To show you the extent that the flushing of a large main may be felt through the whole system of pipes, I will give an account of an accident that happened to a 40-inch diameter pipe, in the city of Boston, during the summer of 1860, as related by Mr. E.R. Jones, Supt. Eastern Div., Boston Water Works: The former supply of water to Boston was by two lines of pipes from Brookline reservoir, a 30 and a 36-inch pipe. They were laid side by side through Tremont street as far as Dover street, where the 36-inch pipe was reduced to a 30-inch and the two continued to Boylston street. One of the 30s was extended across Boston Common to Beacon Hill reservoir, which it supplied; the other 30-inch pipe was reduced to a 24 and fur-

nished water for the lower districts of the city. Subsequently a 40-inch pipe was laid from Brookline reservoir and connected with the 30-inch pipe in the Common. About six months after the completion of the line a 16-inch blow-off valve, which was placed at Muddy river, in order to empty the pipe in case of needed repairs, separated from the main pipe and was blown thirty feet into the river. Beacon Hill reservoir, containing about 3,000,000 gallons, being full at the time, was emptied and water could not be drawn on the first floors, in the lowest parts of the city."

Mr. HOWLAND. The remark Mr. Hancock made in regard to his blow-off connection being at the bottom of the pipe, and the question Mr. Horan asked of Mr. Holden in relation to air getting into the pipe, called to my mind a question which has often been raised of late, in relation to the best form of branches leading from our pipe. On branches that are put in for blow-off purposes only, it is customary to leave what are called tangent branches, the lower surface of the main and of the branch being on the same plane. But for hydrants or street branches it is customary to take the branch from the centre of the main. For instance, in the case of a 24-inch main and a 6-inch branch, the 6-inch branch is neither at the top nor bottom. It neither serves to carry into it, and so on out of the blow-offs that may be on it, any sediment that is in the bottom of the 24-inch main, nor does it serve to carry along the pockets of air that more or less collect in the tops of large mains, especially in the high points, the little undulations that will get into most of our pipes, the way we are in the habit of laying them. And the question occurred to me whether all our branches should not be tangent branches, for blow-offs from the bottom, and for street work from the top. Thus, in our ordinary consumption, we would keep the top of the water

moving and would draw it out through the house service; and our blow-offs at the bottom will always serve to carry off the dirty water. It has occurred to me, therefore, if it would not be well to have all our branches tangent branches.

Mr. HORAN. In supplying a town with water wouldn't you prefer to draw it from a reservoir eight feet deep rather than from a reservoir twenty feet deep?

Mr. HOWLAND. I think that depends somewhat on the nature of the reservoir.

Mr. HORAN. Take a reservoir that is eight feet deep and shaded by trees, and one that is twenty feet deep and is not shaded, which one would you prefer to draw from?

Mr. HOWLAND. If they were both artificial reservoirs, with perfectly clear bottom, I don't think I should mind which I drew from.

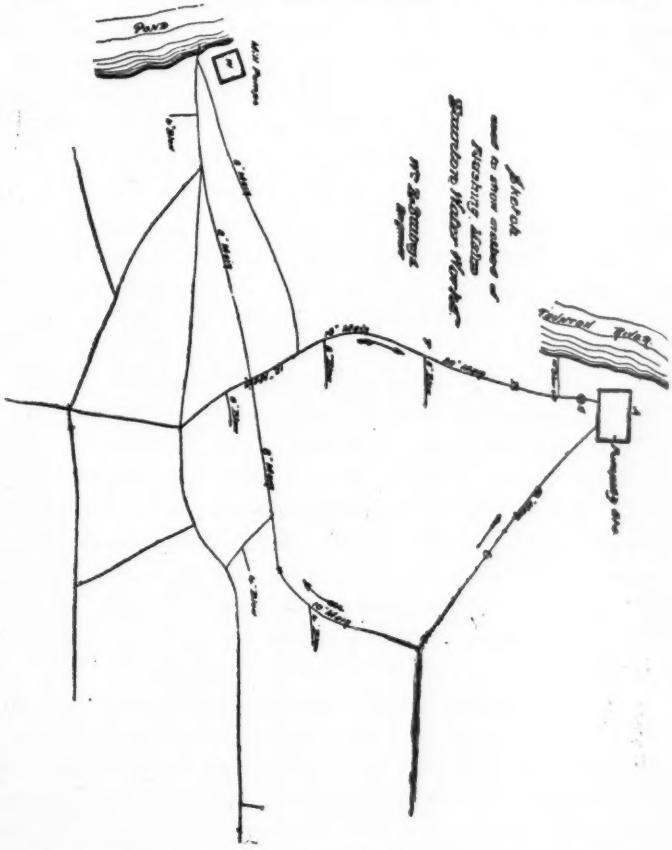
Mr. HORAN. In your opinion, isn't there more likely to be vegetation in a reservoir where there is a large storage capacity, than in a small one?

Mr. HOWLAND. Yes, that is so, within certain limits.

Mr. HORAN. I suppose in that case you would rather draw from the top than from the bottom of a large storage reservoir?

Mr. HOWLAND. Not always, no, sir. I like to have a choice at different seasons of the year. I might illustrate that by referring to works which were built under my direction at Menominee, where we took the supply from Green Bay, on Lake Michigan, at a point where the water was 22 feet deep. We had an arrangement by which we could draw from the bottom, or eight feet from the bottom as we pleased, according to the quality of the water. My preference would always be for a deep, clear reservoir, with facilities for drawing from three or four different depths.

Mr. BILLINGS. I will show how we flush the pipes in Taunton, and this sketch may perhaps help me in my explanation. A may indicate the position of the pumping

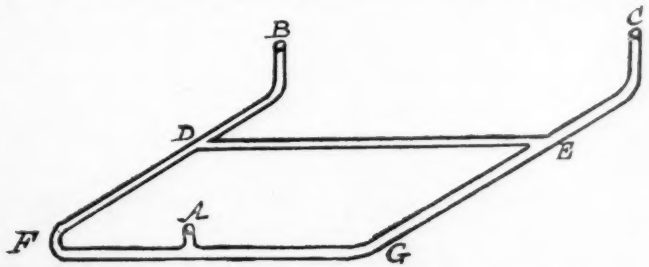


station. B is the original 20-inch main to the city, and C the 12-inch main laid some years after. At W there is a large mill established which has in its plant Worthington pumps of

perhaps half a million capacity connected with a small mill pond. Once a year, generally in the month of April, and beginning on Friday night at midnight, having first given notice in the papers, the gate G on the 20-inch main is closed and all the water is pumped around through the 12-inch pipe. Unfortunately we have nothing but an 8-inch to connect with the 16 and 20. The mill pumps at W are set going for the purpose of keeping the pipe on the upper level full. I don't remember exactly at this moment what the level is, but, perhaps, it is 25 feet higher at W than at A. The engines are started and we run as fast as we can without carrying over 80 pounds pressure, and we put all the water around in the direction of the arrows, producing a reverse current in the 20 inch main with all the water the 8 inch pipe will carry, and discharge from a 10-inch blow-off into the river. We keep this going from midnight till five o'clock in the morning, perhaps, and by that time we get as clear water through that 10-inch blow-off as we could get if we ran longer. Then pumping is stopped, and I generally find it convenient to wait until about half-past five or six o'clock in the morning. Then the gate G and the blow-offs are opened in succession. We begin at F, working into the city, and as many of the blow-offs are opened as the engine will stand without running too fast. Having a thorough flushing through all these blow-offs, and one or two more which I have not indicated, we finish by opening the hydrants on the dead ends; then having finished with the heavy blow-off work, pumping at W is discontinued, for when we get down to the simple hydrant work, the engine at A is sufficient to take care of it. I find we empty the 20-inch main about eight times. And, incidentally I may mention as an illustration of the difference between a simple fire pump which is not built for economy, and an engine which is built on more economical principles, that it takes ten times as

much coal to pump a million gallons at W as it does at A, and these Holly engines, as you know, are not famous for high duty either.

Mr. NOYES. A few days ago the engineer in charge of the Water Works in Providence, Mr. E. B. Weston, whom I was visiting, related to me a little experience he had in flushing the mains in that city. I was quite interested in the matter, and so I will tell it to you, although not being familiar with the size of the pipes, I will not venture to give the details. He had the low service reservoir emptied, and then he opened the gates, and allowed the water to run from his high into his low service reservoir, the idea being that the velocity in his pipes would be sufficient to thoroughly scour them. The two mains on the different sides of the city were of different sizes, and the question was how much of a scouring the lateral pipes between the two mains got. There was some considerable discussion in the office as to whether they got any scouring at all. He maintained that they did, and for the purpose of proving it, he made a very simple device which proved it pretty completely. This sketch shows the arrangement of the pipes, as I remember it: He took an inch



and-a-quarter, or an inch and-a-half pipe, placed horizontal, made with an inlet from the main at A. There were elbows or bends at B, C, F and G, and between D E he had a glass

tubing, which might have been one-half inch in diameter, used to represent the laterals in the pipe system. The outlets B C were exactly the same size. He allowed the water to flow through the pipe at A. When the outlets at B C were of the same size, there was no current through the glass tubing, the velocity of the water through pipes A, F, B and A, G, C being the same. Bushing down the outlet at C, so the outlet was smaller than at B, he got a greater velocity in pipe A F B, and the bubbles of air in pipe D E showed a very considerable velocity through this pipe, proving conclusively that he got a flush through the lateral pipes of his distributing system.

The PRESIDENT. Do I understand you that there was simply one tap into the main?

Mr. NOYES. In this particular case there was a rubber tubing from the supply pipe to this point, so that with the outlets of equal size he got an equal velocity through these pipes. The question was whether there was any current through these laterals. By bushing down at C, so that the outlet was smaller than the outlet at B, he got a greater velocity through pipe A F B than through this pipe A G C, but there was a considerable current then through D E. His mains were of different sizes, and I think he regulated them by the opening of the different gates a certain amount. He went into it mathematically pretty carefully, to prove that he had such a velocity through his pipes, and he thinks he had.

Mr. BILLINGS. The glass tubes were made to represent the small pipes of the distributing system?

Mr. NOYES. Yes, they were made that way, so he could see if there was a velocity through these laterals. There is something more suggested, although, possibly, it is a little foreign to the subject. Mr. Holden spoke of preferring to

put in larger service pipe, because he was troubled with the smaller ones filling up. The matter has been brought to my attention by a somewhat practical plumber in our city, who has always maintained that the smaller our service pipes, if they are of iron, the less likely they are to fill up with rust. He maintains, and always has maintained in his practice since we began putting in tarred iron pipes, that we should not put in any above a half inch, unless the consumption was enough to make a very considerable velocity through the pipe. Since he spoke to me, I have given considerable thought to the matter, and I think, from what has come under my observation, that he is right in his conclusion, and that where a large pipe has been put in, it has filled up quite rapidly, while a half-inch pipe has kept comparatively clear.

Mr. HOLDEN. Mr. Noyes' experience is entirely different from mine in regard to that. A great many of our houses have been supplied by half-inch pipes, and in two years they have been entirely filled with rust. We started to put in three-quarter-inch iron pipe coated, but for the last seven or eight years we have used tarred pipes. These are all filling up, and now we put in inch pipes. Inch pipes that were put in when the works were first started have not bothered us much yet, but nearly all the three-quarter-inch pipes are so filled up that we can get but very little water through them. The works in Lawrence were started in 1875, and at first they put in 800 half-inch service pipes. I think they used the galvanized pipe. They all filled up, so every one of them has been taken out now, and nothing is used but lead. I think the larger the pipe is the less the liability of its filling up.

Mr. HORAN. Have you an analysis of the Merrimac River water?

Mr. HOLDEN. I am just now having some very accurate analyses made of the water in the river, and also of the water in our gallery and in our reservoir, and of water taken right from a house faucet, by Prof. Cabot of Boston. He is also making an analysis of the silt in our conduit, and of the sediment that collects in the conduit and gallery, and also of silt taken from the river. He was up to see me day before yesterday, and he told me he thought he should have it ready in a few days. We usually have analyses made about once a year of the water from the river, gallery and some house faucet.

Mr. HYDE. My experience with service pipes is that pipes which are laid in the ground rust very much slower than pipes hung up in house cellars. Different temperatures, I find, affect the pipe more or less in causing it to rust. As to half-inch pipe being less liable to fill than larger pipes are, I cannot say I have found it so in my experience. I have found in several cases, however, in cellars where there are furnaces and the cellar is dry, half-inch pipe in good condition, while in many other cases three-quarter inch pipes are badly rusted. Most of the pipes that have been put into new houses are half-inch pipes, but we probably have a thousand that are so badly rusted it would be hard, looking through two feet of the pipe, to distinguish a person.

Mr. BABCOCK. I would like to inquire what kind of pipe the gentleman uses?

Mr. HYDE. We originally put in tarred iron pipes. For the last three years we have been using iron, enamelled. This year we began to use lead.

Mr. BABCOCK. Do you find the enamelled iron pipe rusts?

Mr. HYDE. We find they last longer than the tarred iron.

Mr. BABCOCK. You mean black enamel?

Mr. HYDE. Yes, sir.

Mr. DARLING. I am not a little surprised to hear some of the gentlemen say that they have to flush their pipes when they have to draw their water from reservoirs, that is, through screens. What did surprise me greatly was to hear the gentleman from Taunton ever had to flush his pipes, for I understood they had the finest filter gallery there was in the country there; that there was nothing which could surpass it, and that the water was perfectly clear and pure. I can't understand why he should have to flush his pipes?

Mr. HOWLAND. Mr. Noyes' remarks in regard to flushing the laterals, the smaller connecting pipes, in Providence, has recalled to my mind an instance related to me by Mr. Briggs, of Terre Haute, Ind., on one of my visits to him there. When the water works in that city were built, they were built for a town about ten times the size of the city at that time. The city was laid out in rectangles, and there were miles and miles of streets piped which had no houses on them. Most of the houses were on long lines of parallel streets, and there were no houses on the cross streets. and it remained so for years. He had gone on flushing his mains, but had not paid much attention to his connecting pipes. One day a man who had built a house in the centre of one of these cross streets, reported that he couldn't get any water. An investigation showed that the pipe was almost, if not completely filled with mussels' shells. A further examination showed that nearly all the cross-connecting pipes were in the same condition. I think, probably, hardly any two of his long parallel mains were of the same size, and, of course, the velocity must have been different in them in flushing and in using, and there ought to have been some small circulation, at least, through the connecting pipes. But it seems there

was not enough to prevent the mussels forming and filling the pipe completely up.

The PRESIDENT. I should think that in such a place as that, certainly, it would be advisable in flushing to follow out some such plan as has been suggested here to-night, by shutting off some of the main gates and forcing the water through the laterals. I see no reason why that could not be done.

Mr. HOWLAND. I think Mr. Briggs does that now.

DISCUSSION OF MISCELLANEOUS TOPICS.

Mr. BROWN. I would like to inquire what is the best material for packing water gates. Our gates have been put in about three years and I find that in most of the first ones the packing has all rotted out, and during the past year I have had to re-pack probably a hundred of them. I use tallowed hemp,—hemp filled full of cold tallow,—as full as we can fill it, and pack in that way. I would like to know if there is any material that will last any longer or be any better than that.

Mr. HYDE. Our gates, and I suppose all gates, are packed, at the factory where they are built, with fine Italian hemp. I have found, in some of my older gates, that the packing became very hard, and in some cases rotten, so it all came to pieces. I use now, and have for two years, a packing that is made at a factory. It is dipped in plumbago and oil, and I find that it works very nicely. It does not stick to the spindle, and time, so far, seems to have no effect upon it at all. I took one out a week or two ago, which I put in, I think, nearly four years ago to try it, and it seems to be in as good condition as the day it was put in.

M. SCHLEITER. What does the gentleman call it?

Mr. HYDE. I don't know what it it called. It is made by the Silver Lake Company, in Boston. It is a graded packing, filled with plumbago and oil, and there is no sticking to the spindle, or anything of that kind. And it seems to hold its life; so that in four years it is as good as the day it was put in.

Mr. SCHLEITER. Is it a square packing?

Mr. HYDE. No, sir; it is a round packing, like old rope.

Mr. HOWLAND. I should like to ask if there are any gentlemen who make it a practice to oil the packing on their gates periodically, and if so, what method they employ?

Mr. HOLDEN. Once a year I send a man to every gate in the city. It generally takes two or three months to go around to all of them. He goes to each one, cleans it out, if there is any dirt, looks at the condition of the box to see if that is rotting, shuts down the gate and opens it again to see that it is all right and if it needs packing, and at the same time he puts a little oil on it, just before he shuts it down, so the oil will work in while he shuts down and opens. Last year we found 75 gates, and the year before 50, that were leaky. They were all right until he began to start them, and then they leaked. On taking out the stuffing.box, the packing seemed to be entirely rotted away, nothing left of it.

Mr. HORAN. Are your boxes large enough for a man to get into?

Mr. HOLDEN. Yes, our boxes are large enough so a small man can get down in without any trouble. Our covers are 20 inches square, and the boxes are flaring, so they are nearly three feet square inside at the bottom, and a man has plenty of room to get down in and fix the gates. All our gates larger than 12 inches have gears, and these have large brick gate chambers, about six feet wide and eight feet long,

covered with a large stone, so a man can get in there and clear the gears all out and oil them and do anything he has a mind to there. He has plenty of room to work.

Mr. STACEY. I think if any person will take his hemp, soak it in tallow, and give it a thorough soaking in the best of plumbago, so it will be completely saturated, braid it up tight, and put it in the same as you would around a piston, he will have a good packing that will last a long while and never need oiling. Plumbago is one of the best lubricants in the world and if you saturate your hemp with that, you will have a packing that will not want oiling for a long time.

Mr. HYDE. That is the experience I have had with my packing.

The PRESIDENT. If there are no further remarks on this point, I will ask that some other topic be suggested. I would like myself to bring up one topic that was lightly touched upon by some one this afternoon, I don't remember who, and that is as to the depth of lead joints. I suppose there are superintendents here who are using all the way from an inch and a half or an inch and three-quarters to two and three-quarters inches, and I should like to hear some discussion upon that question. What is the depth of your joints, Mr. Brown?

Mr. BROWN. The bells on the Boston pipe are four inches deep. The city of Boston is very fond of lead and iron, and we use plenty of it.

Mr. HYDE. We use a narrow, concave bell in Newton, two inches deep; we use about an inch and a quarter of lead. We find that answers all purposes and we have as tight joints, I think, as any works in the country.

Mr. CHASE. I should like to inquire if two inches is the extreme depth of the bell.

Mr. HYDE. Yes.

Mr. NOYES. It is the "Providence" bell.

Mr. HYDE. The four and six inches are two, the eight and twelve are two and a half.

Mr. HALL. I should like to inquire, where the depth of the bell is two inches, how much of that space is taken up by the bead on the spigot end of the pipe?

Mr. HYDE. I should suppose about half an inch.

Mr. BILLINGS. It seems to me the depth of the lead should be regulated by the depth of the bead. Any lead that goes beyond that is of no value whatever.

The PRESIDENT. Iron costs only so much a ton, and one shape of the bell is made as cheap as the others, but it makes a difference of several cents a pound in the amount of the lead used.

Mr. HOWLAND. I think the more lead you get beyond the bead the stronger it will be. I don't believe it is policy to slight work under ground, and it is better to put in too much lead than too little.

Mr. BILLINGS. I am in favor of thorough work, but I was laboring under the impression the bead did most of the holding.

Mr. BROWN. I should like to ask if any one can tell me how far, in caulking a joint, any impression can be made into the lead?

Mr. JOY. I was just going to state a little experience I have had on that subject myself. A friend of mine, who has experimented on it considerably, tells me that an inch and a quarter is the deepest he could perceive that he could drive the lead. He had some old bells, and afterwards cut them open, and he claims that when you put an inch and a half of lead into a joint, you are getting all that you can drive, and that the other is surplus lead, and is loose, so to speak. Of course, it may fill up any depressions or unevenness there may be in the bell or spigot, but he claimed for any effect you

could have on the lead in driving it to make it tight, an inch and a half was the extreme. I will state that in my own experience I do not believe I have ever used over an inch and a half of lead, and in small pipes it is oftener an inch, and it is very rare that I have a leak. I turned on three miles of pipe last winter and I had but one leak, and that was because the joint was not driven at all. When we dug down to it we found it had been skipped entirely, never had been driven a particle. We turned the water on the first of December and we haven't had a single leak yet.

Mr. HORAN. I suppose where you used an inch of lead you were the consulting engineer?

Mr. JOY. I build the works myself. I don't ask any questions of any one, but get out as cheap as I can.

Mr. BILLINGS. I may add one more bit of experience. I would say that during the last three or four years we have not put over an inch and a half into any of our joints, and all but one or two of the leaks we have had since 1879 have been on the old contract joints where the lead was anywhere from two to four inches, because it was easier to pour lead than to pack yarn. I don't recall but one leak on pipe where there was but an inch and a half of lead.

Mr. HOWLAND. How deep are your bells?

Mr. BILLINGS. Most of them are an inch and three-quarters.

Mr. HOLDEN. I laid a 24-inch pipe across the bed of the river a few years ago, and on that I didn't use any gasket at all. I put a clay roll on the inside of the joint, filled it full of lead and caulked it on both sides, inside and out, so it was all solid. I wanted to make a thorough job of it, because if it ever did leak, it would be very expensive work to repair it.

Mr. BRAND. I have been very much interested in the remarks on this question, and I was pleased at what Mr. Billings said in relation to the bead. I am strongly of the opinion it is not the lead which makes the joint. And the reason I am so strongly of that opinion is that it is the result of my experience. We use cement pipe in Norwich, with a few exceptions, except where we have been obliged to put in iron to keep the pipe together. [Laughter.] I have made some experiments in regard to the amount of lead necessary to be used, and I have found in my practical experience that if I fill the bell up to the inner space of the bead, or the recess in the bell, and fill that with lead to that point and caulk it well, I have as good a joint as I could possibly get. When I said it was not the lead that made the joint, I was going to relate an experiment I made in several instances, where my fire was not convenient at the time and I was in haste to repair the pipes. I caulked the joint with plain gasket till I got up to the inner space of the recess in the bell, then I took some white lead and drove it home firmly, and I have never had a better joint on the works than I made by that operation. I have had occasion since that to take out several hydrants (and it was hydrants that I fixed in this way), in relaying the cement main, and I found it more difficult to separate the joints made in that manner than those made by lead; I mean unless I applied fire to melt the lead. Take my lead joints, as they run, and two smart men can pull them apart, I holding the hydrant myself. But I will defy five men to get a hydrant off a piece of pipe where the joint is made with the gaskets driven well home.

Mr. HORAN. What is your pressure?

Mr. BRAND. One hundred and ten pounds.

Mr. HORAN. Would you put a plug in at the end of an iron pipe in that way?

Mr. BRAND. I had just as leave put it in that way as with lead. It is not lead which makes the joint, but it is the gasket.

Mr. HOLDEN. I can't agree with that statement that the gasket makes the joint, because, when we take out pipe that has been in for several years, we find the gasket is all rotted away and there is nothing left of it hardly; you can pick it out with your fingers. Perhaps, however, if it is dipped in white lead, that may preserve it, but plain gasket will rot.

Mr. BRAND. I would not claim that the gasket would not rot where there is no preparation applied to it. My point is simply this: The gasket is put in there, and then we pour in the lead to hold it firmer. The packing may rot, and yet you will have it held there by the lead being driven well home. The same effect is obtained by driving these prepared gaskets home.

Mr. SHERMAN. I have seen specifications calling for the laying of force-mains, which ask to have the contractor fill the joints with lead the whole depth. Perhaps some of these gentlemen can tell whether that means really full of lead, or whether it is understood there is to be a gasket to keep the lead from running through.

Mr. HOLDEN. We simply put a clay-roll inside of the pipe, then put a clay-roll on the outside, and fill the joint full of lead, and then we had a man on the inside to drive and one on the outside.

Mr. JOY. I will say that all our pipes, as they are in any town where there is a direct pumping system, are really force-mains. Our main pipe is a 14-inch pipe, and in that 14-inch pipe we are supposed to have an inch and a half of lead at the extreme. We have driven out two or three joints, when there was only an inch, or scant of an inch, but in such we have always found they were driven very little. We have

never blown out any joint that showed it was properly put in.

Mr. STACY. If it is true that the gasket makes the joint, most anything that would hold it would answer, no matter whether you could caulk it or not. A proposition has been made to turn the end of the pipes so as to get rid of the necessity of using yarn, because of its decaying and contaminating the water. Certainly after the yarn is all rotted its strength is all gone and it is useless after the lead is poured and the joint driven. I have found that if I leave a strand of yarn standing out on one side of the pipe, I can't set the lead back. The yarn has to be driven home first. I don't see how the yarn has anything to do with the joint except to make it a backing for the lead. I think the lead makes the joint, and I have got some lead joints down my way I don't believe any two men can pull out.

Mr. CHASE. I was a strong believer in 4-inch bells and two inches of lead, until about two years ago, but I have changed my mind since. I started this subject this afternoon, and I can say no more than I said then, that we have some twelve miles of pipe laid with very shallow joints, 6-inch pipe with only seven pounds of lead, and we have had no cases where the lead has blown out. I don't see any reason for using more than an inch and a quarter of lead on any ordinary sized pipe. While I am on the subject I would like to relate a little incident, which may be of use to some of you, in connection with pouring a lead joint that is wet. I don't mean one that is merely moist, but one that has a considerable stream of water running through it. We had occasion some time ago to make some lead joints where there was a stream running through the bottom of the joint fully as large as my thumb, and any dam that could be put inside would be carried away by the pressure. It was a long time

before we could get the joint together. It happened to be in a railroad yard, where there was a great quantity of oil waste lying around, and we made a gasket of that and poured the joint, and we have never heard anything from it. Several times since then I have sent up to the railroad yard to get oil waste for gaskets to make joints.

Mr. Nevons. We are handling considerable lead, and I am interested in the subject. I think I shall learn something. I don't know whether any of you gentlemen have ever seen a hydrostatic joint made, but I have made a hydrostatic joint, where there is no gasket at all, and I have seen it put to a severe test. I have seen the pipe deflected all you can deflect it, which is somewhere about six or nine inches, and still the joints were good, and the lead was simply put in with a hydraulic jack. The lead is all poured into the lead groove in the bell, and the hydraulic jack is put on top, and the lead is forced right out around. So I think the gentleman who takes the ground that lead does not make the joint, is a little off. When you have got your lead in past the lead groove, I don't see what good any more lead does, unless you are deflecting your pipe. The main point in making the joint is to run your lead in solid and then drive it in a little by the edge of the bell. I think every joint should be driven solid, but when you come to talk of upsetting the lead, I don't believe you can upset it more than an eighth of an inch anyway, and I can't see, if you are laying the pipe on a true line, what good it does to run the lead beyond the lead groove. We are now laying 30-inch pipe deflecting from a true line, and we do what caulking we can inside. I should like to hear the opinions of the different superintendents here about driving the joints. I have talked with one old superintendent who wants the joints rounded up outside of the bell. He has got a 24-inch force-main which was laid some

17 years ago, and they were so afraid of using lead that one of the members of the board stood over it all the time with a stick cut just an inch and a quarter. Only two of the joints on that force-main have started since it was laid, and those were not driven. I should like to hear, as I have said, the opinion of the members with regard to driving the lead, as to how far it will be upset.

Mr. BRAND. I do not wish to be understood as saying I would not use lead in making a joint. The very point I wished to make in relation to the white lead gasket was that it answered the purpose of lead. I claim, of course, that you have got to have something to hold the gasket, and my point was that there was no need of carrying the lead beyond the lead groove. The point I intended to make was that the white lead gasket would answer the purpose of lead.

Mr. NEVONS. There is one thing more I would like to inquire about. Something has been said about working lead joints out. That is something I could never do. I have found it a good deal cheaper to build up a fire and run the lead out. We have taken out a great many lines of pipe and the best we could do we would break the pipe, unless we went to work and cut out or burned out the lead. I never could get the joints apart in any other way when they have been put in properly.

Mr. HOLDEN. Has there ever been any machine invented for cutting out a lead joint? I am anxious to know, for I have got some 23-inch pipe to be taken up.

Mr. NEVONS. Put a fire under them.

Mr. HOLDEN. I cannot get a fire under them, it would be impossible to.

Mr. JOY. I have often used a narrow cold chisel to cut joints out with.

Mr. HOLDEN. How long does it take?

Mr. JOY. I have never seen them cut out anything larger than an 8-inch, but they cut that out in a very short time.

Mr. CHASE. As a sort of off-shoot of this question, I should like to ask if any one has had any experience in taking up a long line of 12-inch pipe, and how they would set at work to do it without burning the joints to get it apart. I know one man has done it, but my inquiry is not aimed at him particularly. I thought someone else might have had such an experience. I refer to a line of five or six thousand feet.

Mr. HYDE. I had a little experience last winter in taking up eight or nine hundred feet in two places where the railroad was going across our pipe. I took up about 900 feet of 12-inch pipe in both places. The way I did that, I cut the bell off of one pipe, put a derrick on to the end of the pipe, and lifted the pipe up as high as I could, threw some dirt under the bell of the next one and let it down to get a leverage. Then I had two or three men stand on the end of the pipe and bear it down as much as possible, and then raised up with the derrick again, and another man struck on the bell with a heavy mall, and in that way we worked them all out and got them all out whole.

The PRESIDENT. It seems to me that this matter of taking up pipes is very much complicated by the depth of the lead.

Mr. CHASE. A 3-inch bell would be different from a 4-inch bell.

Mr. HOWLAND. I have had occasion two or three times to take out some 8-inch joints, but in each case I had an opportunity to get an end motion on my pipe. I did it with a couple of jack-screws, one on each side of the bell, and forced it directly off.

Mr. CHASE. I had thought whether I could not rig up a frame carrying a couple of hydraulic jacks which could be dropped right down over the pipe in such a way as to bring a bearing over the next one back, and do the work expeditiously. I thought perhaps someone had had experience in that direction. I should like to ask Mr. Hyde the cost per joint of taking them apart as he suggests?

Mr. HYDE. I could not tell you the cost, but it was very much less than burning the joints. It also saved burning the tar off of the pipes.

The PRESIDENT. About how many joints could you take apart in a day? That would answer the question practically.

Mr. HYDE. I took up the 900 feet in a little over a day.

The PRESIDENT. Took it all apart in a little over a day?

Mr. HYDE. Yes, sir. We used a wheel derrick so I could get a heavy purchase on the pipe and raise them up as high as possible. We would raise, perhaps, three lengths back. Then I would pile some dirt back of the bell of the first pipe, and let that down, and let two men get right on to the end of the pipe, and another man would strike the bell with a heavy mall.

Mr. COGGESHALL. In partial reply to a question asked by Mr. Holden some time ago, I may say that we purchased a naphtha lamp last year, which works on the sameprinciple as a gasoline furnace. You hold it in your hand like an ordidary lamp, and you can force a tremendous flame almost any distance you require. Taking a kettle of solder you can melt it down very quickly. The idea that I had in purchasing it was to apply it to melting out joints, and I think it will work well although we haven't tried it for that as yet.

Mr. HYDE. I bought one of those same lamps for the purpose of burning out joints. I used it half an hour and then I threw it away. [Laughter.]

Mr. HOLDEN. That was just my experience. I tried it on a 12-inch joint and found I could not do anything with it. But I have found one of those naphtha lamps a splendid thing for thawing out where a pipe has frozen in the cellar wall. It will thaw out a pipe in a very short time.

The PRESIDENT. They came around in Springfield with this same lamp and Mr. Hancock took it out in the back yard and experimented with it. He didn't buy the lamp. [Laughter.]

Mr. HOWLAND. I should like to ask Mr. Nevons his reason for preferring to have the lead driven back beyond the face of the bell.

Mr. NEVONS. All joints I have seen are joints that have been rounded up on the outside. My theory is, and I have proved it by practice, I think, that if you get the lead driven in there, there is no danger of the joint playing. If the joint starts after it has been driven it is pretty sure to leak. If there is any deflection caused by the pipe settling, or anything of that kind, which is liable to happen in many places, it will draw the joint, perhaps on top, perhaps underneath. You don't upset the lead more than an eighth of an inch anyway, and if that is upset on the outside it does no good. In our city we have to provide against the settling of the pipe, and I don't see why they are not liable to settle in most any place, owing to careless bedding, and if they settle and are deflected from a true line, the joint must draw, but if the lead is driven inside it can't draw out.

Mr. HYDE. We drive our joints about a sixteenth of an inch back of the edge of the bell. Our caulker is a man who learned his business in England, on the water and gas works

there, and they always caulk the joints in that way. He claims it makes it stronger, although I don't know why, and he always does it. I am using one of those patent pipe-joiners, and I like it first-rate.

Mr. HOWLAND. We experienced some difficulty in driving it back, for it doubled and turned in under the edge of the bell, which was inconvenient. I, therefore, cut out a groove on the inner edge of this rubber gasket, so as to leave the lead projecting a trifle, and calculate to drive it so it will be flush, and in that way I find I never have any trouble at all.

Mr. NEVONS. I have used up one. The first one I had I took into a planing mill, where they had a big-toothed saw, and they sawed out a place about an eighth of an inch. I found in using this gasket, setting it up time after time, that it "squat" up, so now I take my knife and cut the corner of it right off. The last one I made I got our engineer to put the rubber on. I have a man take the corner off once or twice a day with his knife, and that leaves it projecting, as Mr. Howland says. The only fault I have found with that is, that if you use it flush it don't leave the joint quite full enough.

Mr. HOWLAND. When you pour it flush, how far back can you drive it?

Mr. NEVONS. About an eighth of an inch.

Mr. HOWLAND. You calculate you don't upset it more than that?

Mr. NEVONS. No, sir.

The meeting then adjourned to 9 A. M., Friday, June 19.

FRIDAY'S SESSION.

Springfield, June 19, 1885.

The Association was called to order by President Ellis, at 9.10 o'clock A. M.

The PRESIDENT. Before proceeding to the reading of the papers, I would ask the Secretary if he has any business to present at this time.

The SECRETARY. Since the meeting yesterday morning, at which we acted upon the applications for membership, which had at that time been received, we have received applications from the following named parties for active membership: Josiah Reed, Commissioner, Weymouth, Mass.; H. R. Stanhope, Supt. of Construction, Springfield, Mass.; John F. Chadbourne, Supt. of Construction, Haverhill, Mass. I would suggest that these applications be acted upon at this time. The gentlemen are all recommended by some member of the Executive Committee.

On motion of Mr. Sherman the Secretary was directed to cast the ballot of the Association for the admission of the gentlemen. The Secretary attended to the duty, and the President announced that the gentlemen had been elected members.

The PRESIDENT. There is one other matter of business which escaped my mind last evening, when we were upon the election of officers, which would very naturally come up at the same time, and that is the selection of a place to hold our next annual convention. I would inquire, Mr. Secretary, if you have any invitations?

The SECRETARY. Mr. President, I received, the other day, the following communication:

New Bedford, Mass., June 8th, 1885.

To the New England Water Works Association:

GENTLEMEN:—It is with pleasure that I transmit to you a copy of an order passed by the New Bedford Water Board, at a meeting held June 2d, 1885:

Ordered, That the New Bedford Water Board hereby extend a cordial invitation to the New England Water Works Association to hold their next annual convention, which will occur in June, 1886, in the city of New Bedford.

Very respectfully,

[Signed,] MORGAN ROTCH,
Mayor, and President New Bedford Water Board.

On motion of Mr. Taylor the Association voted to accept the invitation, and the Secretary was instructed to tender the thanks of the Association to His Honor Mayor Rotch and the New Bedford Water Board for their proffered hospitality.

STREET MAINS.

The first topic upon the morning programme was "Street Mains; relative merits of the different kinds in use."

The discussion was opened by Mr. Hall, of Quincy, who spoke as follows:

Mr. President and Gentlemen: I am very sorry to be obliged to begin my remarks with an apology. Various other matters have claimed so much of my time and attention of late that I have not been able to give this subject the investigation which it requires. I found at the very outset that an intelligent treatment of the topic demanded a great deal of study, and I, at first, purposed to ask the Association for further time. Upon reflection, however, it occurred to me that possibly something might be said this morning to start a dis-

cussion which would be of more benefit to us all than would arise from any delay made on my account.

By reference to the statistics of American water works, compiled by Mr. J. J. R. Croes, I find that there are four different kinds of pipe in use, which may, in a general way, be classified as wood pipe, made of wooden logs or boards; cast iron; sheet iron lined with cement, covered on the outside, which is commonly called cement-lined pipe, and wrought iron pipe, both plain wrought iron and kaoline pipe. It might perhaps, be sufficient to term them wood pipe, cast-iron pipe, cement-lined pipe, and wrought-iron pipe.

Wood pipe is perhaps one of the earliest kinds used in this country, and it has been in use a long time. Many instances are on record, and I presume nearly every gentleman present has cases in mind of log pipe which he has seen, which are excellent examples of the durability of wood when used in this way. It is now claimed by manufacturers that the liability of decay from the outside has been to a great degree removed. Wood is used to a limited extent in New England. I might mention as among the advantages claimed for it, elasticity and the absence of anything which would affect the purity of the water; and I noticed a few days ago the claim that it was non-freezing. In this connection I will say that according to my idea what might be said of one pipe, in relation to freezing, would apply to all. The best non-freezing pipe I know of is a pipe that is put below the frost line, deeper than the frost ever goes. [Laughter and applause.]

Cast-iron pipe is more generally used than any other kind, and, perhaps, it might be well to take that as the basis and use it as a standard of comparison. Most of us are more or less familiar with the durability and other merits of cast-iron pipe, although, judging from the discussion we had yesterday afternoon, there is still a diversity of opinion on some

minor points, or points of detail. The question is often raised as to the life of cast-iron pipe, and I hope I may be able to draw out something further in continuation of the discussion we have already had on this subject. One objection to cast-iron is the tendency to the formation of tubercles on the inside, and I watched, with a great deal of interest, the discussion in relation to whether the coating which is now used upon cast-iron is a perfect protection against corrosion or tubercular formations. I am forced to the conclusion, both by my own experience and by what has been said here upon this point, that it is not an absolute protection. We find that in some localities it is affected more or less by contact with the water which is conveyed through it. In my own experience with pipe which was laid, probably, in 1845, or previous to 1845, pipe cast horizontally, without any coating, and taken up after it had been in use 36 years, has been that a 6-inch pipe, for instance, would be coated from half an inch to three-quarters of an inch, so that the carrying capacity of the pipe would not equal, probably, the capacity of a 4-inch smooth pipe. I would like information upon the point as to whether the coating which is now used will prevent that. Perhaps this is not exactly a discussion of the merits of various kinds of pipe, but it seems to me it is an important point for us to get information upon, and, if I am not digressing too much from the subject assigned me, I would like to bring this up. I have found this formation already commenced in some pipe which has only been laid from six to ten years. In other localities I have found pipe that has been in ten years which presented no evidence of this formation, and this in the same city. Other parties have told me they have seen the same thing. One man told me, a few months ago, that he had one line of pipe which was in constant use, and has been in use

only a few years, that was now filling up fast; and that another line of pipe in the same city, with the same water, was comparatively free, although it had been in use, perhaps, three times as long as the first described pipe.

Cast-iron pipe possesses the advantage of easy tapping for service connections, strength to resist transportation, and the unnatural strain caused in the digging up of the streets, which is continually happening in all large communities.

One question which is often an important factor in determining what pipe shall be used in the construction of water works, or in making extensions, is that of cost. This consideration was no doubt largely instrumental in the introduction of cement lined pipe, which is now in quite general use throughout New England and the Middle States. Its advantages are cheapness, absence of the oxide of iron, non-liability to be filled up with sediment or deposit which may be in suspension or solution in the waters, and the being able to maintain, so far as I am aware, a free water way of the whole size of the nominal diameter of the pipe. This pipe, when properly laid, forms a good conductor of water. There are many elements in the consideration of the merits of this pipe that give ground for a great deal to be said upon the other side. But taking our cement-lined pipe as we find it throughout New England, considering the fact that many works introduced it at a time when cast-iron was very expensive, costing $60 a ton, or upwards, for the average New England trade, considering the revenue which has been derived from the sale of water, the advantages which have been secured by fire protection, reckoning the interest upon the cost, and taking everything into account, I submit, although many of us are sometimes apt to speak rather lightly of cement-lined pipe, whether, after all, it has not proved a good investment. I have not had time to ascertain any facts in relation to it, in

the way of figures and comparisons, but I venture to throw out the suggestion for the consideration of the Association. My experience with this pipe has been that in from 12 to 15 years it requires considerable repairing, and from 15 to 20 years the fun gets pretty lively.

There are some peculiarities about this pipe, and I have one case in mind. When the city of Worcester first began to manufacture the shells, after the contractor had completed his contract, an agreement was made with a local dealer to furnish them; as it was supposed by the general public, and by the dealers, that anyone who could work sheet-iron, who could make a piece of stove pipe, could make a covering for a cement-lined pipe, and that it was not necessary to go to Philadelphia to buy a certain brand of iron and have a certain man do the work. A contract was made, and quite a number of shells were riveted, which, on examination, were found to be made of what, at that time, was considered an inferior quality of iron, and a kind which had never been used in our city for that purpose before. After inspection and considerable discussion it was decided to accept a part of the work, and the pipe was laid in some of the elevated portions of the city, where the pressure was so light that we thought the cement might hold even if the iron failed. After the introduction of the high service system to supply the hills, this pipe, by connections which were made with the high service, was put under a pressure of from 70 to 100 and 110 pounds to the square inch, and until within two years ago there was comparatively little trouble with it, and I have been informed by Mr. Taylor, since our meeting here, that some of the sections have given no special trouble up to this time, which shows that there is strength in the iron when it is properly protected from contact with water. But, taking the cement pipe as we ordinarily find it, with the rivets from an inch and

a half to an inch and three-quarters apart, with the laps left up far enough so you can see through between the two edges where they come together, it is pretty hard to make it tight by simply lining with cement. The water, owing to the porosity of the cement, finds its way to the iron, follows along this lap, and soon destroys the effect of the covering on the outside.

Wrought-iron pipe has been quite extensively used, though it is of later date, I might say, than cast-iron. It is used both in what is termed plain iron, and in various kinds of coatings. Lately the kaoline coating, with which my experience has been limited to perhaps a year and a half, has come into use. I have found no evidences of corrosion as yet, but the test of time has yet to be applied. We have the test of time for cast-iron and, to a considerable extent, for the cement-lined. But, so far as my information reaches, we at present have no data which throws much light on the durability of wrought-iron pipe.

One other point of great importance in selecting pipe has been touched upon here, and that is a consideration of the character of the water to be conveyed through the pipe, and the character of the soil in which the pipe is to be laid. The importance of this is shown by the fact that while pipe which has been in use for many years in some localities is still in a good state of preservation, the same kind of pipe which has been in use a much shorter period in other localities, has given out. It seems to me it is important for us to be familiar with the constituents of the soil, chemically considered, and also with the peculiarities of the water.

This, in a general way, is all I can say at present, Mr. President. I hope that the discussion to follow will be of interest.

Mr. Gow. I have had some experience with this cement pipe, for we have had it in our town for 16 years. It was laid by a contractor. I have had considerable experience with water works, directly and indirectly, and principally with cement-lined pipes. I was under George H. Norman, contractor, in the city of Charlestown before it was annexed to Boston, and that was my first experience in New England. Previous to that I had experience under the people who got the patent on this pipe, although not with the present Jersey Water and Gas Pipe Company. My first experience was in the Provinces, in the little village across the river from Saint John, N. B., and I handled cement pipe there for the first time. When I saw it I thought it was a curious kind of a water pipe, and I had no faith in it. I was employed there to make some connections and to do soldering on service pipe that was made out of sheet tin lined with cement. I thought it was a funny kind of a water pipe, and I was surprised to see it stand the pressure.

Well, from that out, and after I came to the New England States, I was employed by Mr. Norman, as I have told you, first in the city of Charlestown. From Charlestown I went to Chelsea, from Chelsea to Salem, from Salem to Beverly, from Beverly to Lynn, Malden and Medford, where I am at present, and have been stationed there these last 15 years.

I have had considerable experience with cement-lined pipe. About 15 or 16 years ago the patent expired on this pipe and the Water Commissioners asked me if I thought I could make it. I told them yes, I could make it. Well, they said they would like it. I said, "It is not for me to say whether you like it or dislike it, it is your pleasure to have what you want." They asked me if I could make it and lay it as cheap as Norman could. I told them certainly I could,

and better. [Laughter.] Well, I say better and I think I did it better. There is considerable talk about this cement pipe. I don't care about cement pipe, and no more about iron pipe. I can take either of them, and I have both of them. I have had experience with both of them. I am one of these fellows that never say die. If a man asks me if I can do anything, I always tell him, "Yes, I can do it." I never shirk anything. But I say that when we are dealing with cast-iron pipe we are dealing with a certainty; we know what we have.

There is one thing about this cement-lined pipe, and that is, as Mr. Hancock said here this morning, a good many people haven't experienced it yet. I have experienced it. I don't know how the American Water & Gas Pipe Company, and the Jersey Water & Gas Pipe Company, and Goodhue and Birnie manufacture this pipe, but I know how the Jersey Water & Gas Pipe Company used to do it. When they had a job in any city or town where they were laying this pipe, the shell was manufactured in Jersey City. It was put out to men by contract, and the more these men riveted and made in a day, the more money they made. They didn't care a button how the pipe was made as long as they got it off the mandrel. The seam was not laid down flat. It was all buckled up between the rivets, and the consequence was, and is now, where this pipe is laid, there is trouble. Of course anyone here who is acquainted with cement pipe knows how it is covered. There is a ditch dug, and the pipe is laid down, and two men with a trowel cover it right over. When the water is let on to the pipe, the cement will absorb so much water that the water is bound to go through this seam, and between the outer shell and the covering there is created a pressure which throws the covering away. It does not throw it entirely away, but splits it, sometimes. I have

known, in cases where this pipe has been laid by a contractor where I am now, where I have taken it up, on breaking the top covering we sometimes cannot get the cement away from the iron, but we manage to crack it all away from the side, till we can get hold of the end of the pipe and lift it right out of its bed, and underneath it leaves a perfect trough, where the pipe has settled down on the bedding.

Another great disadvantage in making the joints is that they have a class of men who go and cover the pipe, and then there is what they call the joint maker,—who is a mechanic,—who comes along and makes the joints, and there is another man who follows him who patches the joints. But in making these joints, sometimes, when they fill the sleeves, they don't fill on to where the cement has been laid. Sometimes it don't adhere. I have had experience in this, and I have found at the end of the sleeve a regular ring right around that is rusted out.

I have been making the pipe in Medford for our town during the last ten years, and have made it for several towns around in the vicinity. Perhaps in ten years more I can give a little more experience on it. But at the present time, as I tell you, I am making it, and I have had no fault with it, no trouble. I never had to go back to one piece of it that I made and laid myself. As I have told you before, cement will absorb so much water, and that water has got to go somewhere, and it is always bound to work out of the seam. When we have a leak, whether it is a small leak or a drip, I dig up and take the length right out, cut it right off, and put in a new length. I don't care how well the seam is laid down, it will always weep out of the seam unless you tar and wind it. Water will weep out of it then for twenty-four hours, but after that, if it is dipped and tarred before it is wound in, there won't be any trouble and you can't see a drip out of it.

But, as I said before, when we deal with cast iron, we deal with a certainty. I am in favor of cast iron, but I never saw any iron yet that the water didn't have an effect on. There used to be across the Mystic River one of those old-fashioned draw-bridges that hoisted with a chain, and we had a half-siphon, a 10-inch pipe, which crossed the river and then went on a slant up on the other side to supply the south side of the town. Well, of course, we are getting more enlightened the older we grow, and the town thought it was an old-fashioned affair, and they would have a new stone bridge, and so they voted to build a two-arch bridge across the river, providing they got through the Legislature the necessary enactment. The river was navigable above that, for there used to be a good many vessels built there before iron ships came into use, and it was necessary to get authority from the Legislature before they could stop the navigation of the river. As I say, we had a 10-inch pipe crossing the draw, and we had to take it out until such time as they put up the abutments for the new bridge. It had been in about eight or ten years. You talk about taking iron pipe out, but I didn't have any trouble about taking it out. The contractor had a steam derrick, and he hoisted the whole thing right out of the river on to dry land, and two or three men knocked the joints and it came right apart. I had no trouble, and didn't have to break anything except an elbow in getting it apart. It was about 75 feet long, and it was hoisted right out. After I got it over into the yard, I examined it and found tubercles in it all the way from a quarter of an inch up to an inch. It was a tarred pipe from Philadelphia. When I scraped the tubercles off I found the iron all eaten away under the tubercles to the depth of from an eighth of an inch to a quarter of an inch.

In another case, 3000 feet of 4-inch iron pipe was laid, under a contractor's contract, in a piece of swamp land where cement pipe could not be laid. Since that time a street has been cut across this line of pipe. I had occasion to cut the pipe to put in a branch, and the Commissioners asked me if I could not lay cement pipe there instead of iron pipe. "Well, yes," I said, "I can lay cement pipe, providing I can lay a bottom to put the cement pipe on." They thought some time whether they didn't want iron pipe. I said, "You can have what you want; please yourselves, gentlemen, it is none of my business; I am here to do your bidding; that is what I am hired for; but I think I shall have to have some engineering about it before I can do it." "Well," they said, "if you can do it, go ahead and do it." I replied, "I will." Well, as I told you, I had to cut this 4-inch pipe, it had been in about fourteen years, and it was tarred pipe. After I had cut out one piece, I didn't want to examine further. The piece I cut out of this line of 4-inch pipe measured about 2 1-2 inches in diameter inside. I didn't make any comment to the Commissioners, but in laying this cross section of cement pipe, which was across a sort of a mud bed, I laid planks on the bottom of the ditch and put the pipe on top of them. The pipe has been laid about eight years, and I have never had any trouble from it.

The SECRETARY. In about thirty-five minutes we are expected to keep an engagement with the Fire Department, so our time is limited. Therefore, although I am sorry to interrupt the discussion of this topic, I move that we proceed to take up the next subject.

The Convention so voted.

WATER WORKS REPORTS.

The next subject upon the programme was uniformity in the preparation of Water Works Reports.

UNIFORMITY IN THE PREPARATION OF THE ANNUAL REPORT.

Mr. President and Gentlemen:—

It has long been admitted that if there could be established a degree of uniformity in the preparation of the annual report, some standard which would be recognized and adopted by all water departments, a result of great value would be secured, and a need long felt be supplied.

Your committee are not the first to suggest some scheme bearing upon the solution of this somewhat complex problem, for it has received attention at every gathering of the American Water Works Association since the first meeting at St. Louis in 1881.

The fact that the problem has been assigned to us by the New England Water Works Association might seem to indicate that previous solutions were not entirely satisfactory, and it is with no little diffidence that we present this attempt; but if our work can serve as a foundation upon which others may build we shall be content.

To secure attention in this busy age results should be presented in such a way as to be seen and comprehended with the least possible loss of time. The annual reports of water departments are yearly becoming of more value and interest to a circle of readers outside the taxpayer and consumer. According to Mr. Croes' tables there are 1008 cities and towns in the United States and Canada having a public water supply, and a carefully prepared report from the

smallest of these can hardly fail to contain items of interest.

The diversity of methods employed in administering the affairs of water departments, and the great variety in the titles and duties of the officers, make entire uniformity in the reports coming from the various sources practically impossible.

We make bold to say that it is a mistake to conceal results, even though they do not always bring the highest praise to the management. The city or town is fortunate which has not its mistakes to record, and an honest mistake in judgment should not be regarded as a stigma. Annual reports should be volumes of condensed experience, presented in such form as to make them acceptable guides for future practice.

As examples of defects now common in annual reports the following may be presented. The attempt is often made to draw comparisons between the statistics as presented by two or more towns. For instance, we turn to the financial statements for the purpose of comparing the total expenditures on account of maintenance, and find at once that the methods followed by the two officials in making up the statements are so different that exact comparisons cannot be made. Again, the word "duty," as applied to pumping engines, has a meaning which varies according to the methods employed in its determination. We see, then, with results expressed apparently in equivalent terms, that the factors used in obtaining them are so different in each case as to render satisfactory comparisons impossible; and therefore it seems necessary not only to agree upon a form of statement which shall classify all the results considered of importance, but processes and formulae minutely prescribing just how the stated results shall be obtained, must be adopted and carefully followed.

Could perfection be attained in this direction it is possible that a satisfactory solution could be reached of certain important questions which seem to remain at present open to discussion. For instance, it is doubtful if the question "Should direct pumping ever be chosen in preference to pumping into a reservoir" will ever be satisfactorily and fairly answered until annual reports from cities and towns, some having one system and some the other, are sufficiently uniform and complete to make possible exact comparisons of conditions and results for a large number of cases.

Another defect to be noted in reports, as generally presented, is the lack of attention given to the description of experience in matters of seemingly small moment. These items are passed over each year on account of the attention demanded by the larger and more important results.

We are often for a time perplexed with some trivial difficulty which we are quite sure must have occurred many times elsewhere, but as no record of such an occurrence has ever been made we do not know where to obtain the information we want. Your committee feel very sure that the value of annual reports would be largely enhanced if more attention were given to these minor matters.

The address and certain features of the report will always have to remain subservient to the plans of the department organization, in which there is so much variety. In most cases the actual management is entrusted to the care of two or three persons. In the larger cities there are generally at least three subdivisions of the management, viz.: "Engineering," "Finances," "Superintendence." In the smaller works all these matters may be entrusted to the care of one person. Your committee feel it important to urge that in all cases the person actually having charge of the details of a work is the proper one to make the report thereon. The

report of the manager should of course be addressed to the board or committee who direct the affairs of the department, and, in turn, the report of the board or committee should be very brief and general in its statements, referring to the manager's report for all detail.

After due consideration of the topic assigned us we have come to the conclusion that perhaps our work can be best accomplished by preparing a specimen annual report, stating as concisely as possible what matter should be included in its pages. You are now invited to inspect the result of our labors in the pamphlet laid before you. We think the scheme needs very little explanation. It has been our endeavor to put into practical form the principles set forth in this paper. The following hints may secure a better comprehension of the plan:

A division of statistics is made into two classes, viz.: general and special. The first includes only those broad topics which are of interest to all, and the results most needed and used in making comparisons. The second class contains the details, or those results having mainly a local interest. It is suggested that all statistics, both general and special, should appear in the body of the report under their appropriate headings, while the general statistics alone are grouped in classes and placed in every report, just following the title page. We feel very sure that this is the most appropriate place for such a statement, as thus placed it will naturally receive examination before attention is given to the details of the report.

For assistance in making comparisons each item of the general statistics is designated by letter or number, for example:—

Duty comes under the division Pumping (10).

Daily average consumption comes under the division Consumption (7).

Receipts from water rates comes under the division Financial (C).

As an illustration of what is possible we place before you the statistics drawn from the last reports of the departments of Taunton and New Bedford, and it is evident that the list may be indefinitely extended.

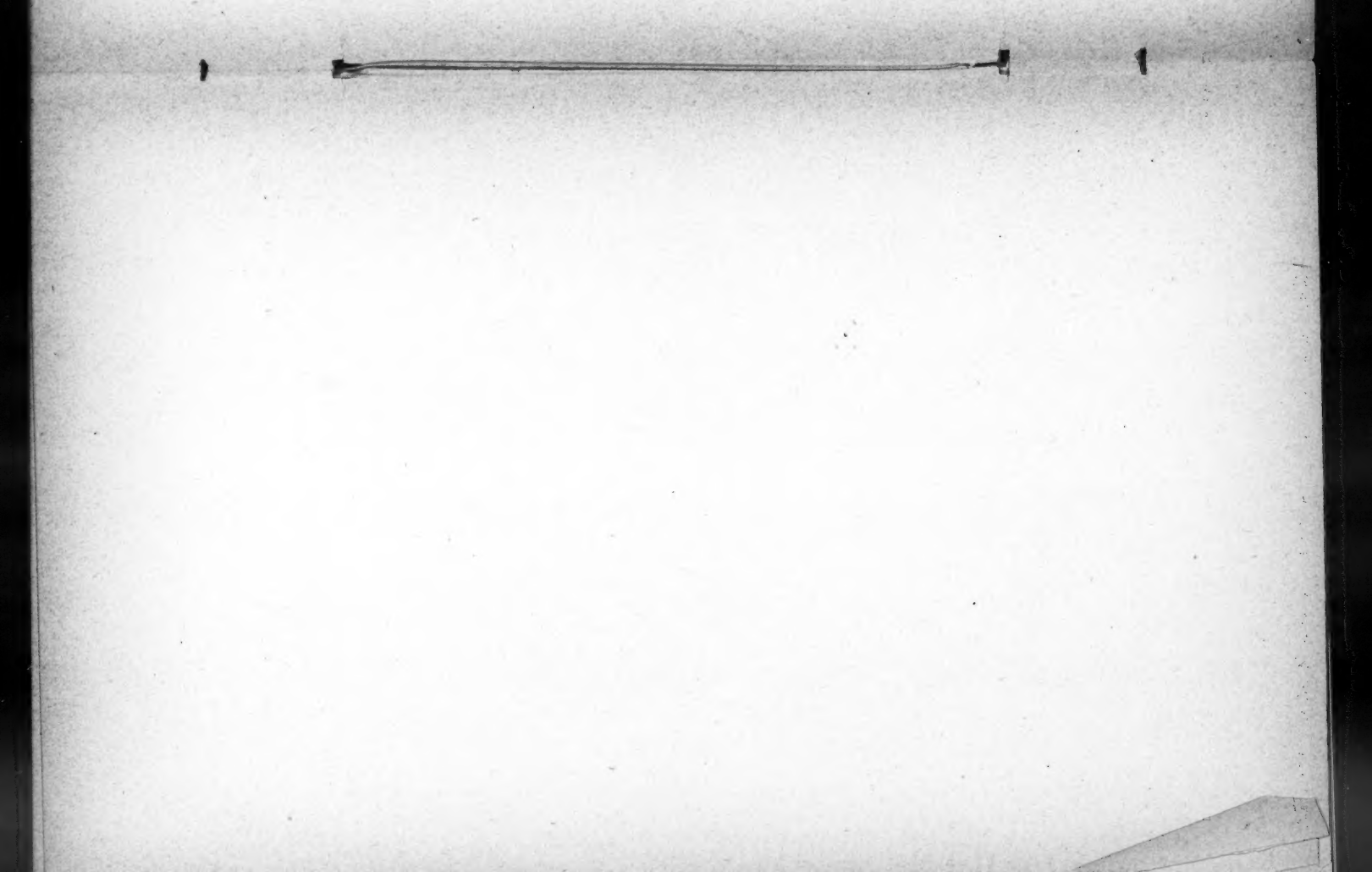
If some such plan as this be adopted a committee of this association might each year draw from the reports of all the water departments represented in this organization these important facts, and, having tabulated them as shown, furnish a copy to each member.

Each member would then have directly before him in the most concise form for immediate reference and comparison a convenient compilation of the yearly work done by water departments, throughout such territory as it may be decided best to cover by such a scheme.

Before closing we wish to testify to our appreciation of the valuable work done in compilation of water work statistics by Mr. Croes, also to acknowledge having included in our work some valuable ideas advanced by Messrs. Croes and Price in their paper presented at the last convention of the American Water Works Association. We are also indebted to the "Sanitary Engineer," and to Messrs. Gerhard, Ellis, Sherman, Brown, Taylor, Schleiter, Wilcox, Dennett, Rogers, Walker, Hyde, Chase, Holden, Horan and Richards, for statements in reply to our inquiry as to what they considered most of interest in the make up of an annual report.

Your committee would now conclude with the suggestion that this scheme be examined in detail by the convention, and that it receive such revision as to make it worthy

of the endorsement of this association, and finally that action be taken to induce, as far as possible, every water department in the organization to adopt it as a model in compiling its annual report.



"THE ANNUAL REPORT."

SUGGESTIONS PRESENTED BY A COMMITTEE OF THE NEW ENGLAND WATER WORKS ASSOCIATION, AT A CONVENTION HELD AT SPRINGFIELD, MASS., JUNE, 1885.

WILLIAM R. BILLINGS, Supt. Taunton, Mass.,
ROBERT C. P. COGGESHALL, Supt. New Bedford, Mass.,
Committee.

SUMMARY OF STATISTICS.

..... *Water Works.*

(Name of City or Town.) (County.) (State.)

Population by census of 188 , ...

Date of construction ..... By whom owned .....

Source of Supply .....

Mode of Supply .....

(Whether gravity or pumping.)

PUMPING.

1. Builders of pumping machinery .....
2. Description of coal used : { *a*. Anthracite. *b*. Bituminous. *c*. Size. *d*. Brand. *e*. Price per gross ton delivered. *f*. Percentage of ash. *g*. Wood, — price per cord.
3. Coal consumed for the year in pounds .....

   For starting fires, etc., consider 3 lbs. wood = 1 lb. coal ; then
4. $\frac{\text{Pounds of wood consumed}}{3}$ = coal in pounds .....
5. Total fuel consumed for year, (3) + (4) in pounds .....
6. Total pumpage for year in gallons .....
7. Average static head against which pumps work .....
8. Average dynamic head against which pumps work .....
9. Number of gallons pumped per pound of coal (3) .....
10. Duty, —using following formula, making no deductions for starting or banking fires, heating building, or anything else.

$$\text{Duty} = \frac{\text{Gallons pumped (6)} \times 8.34 \text{ (lbs.)} \times 100 \times \text{dynamic head (8)}}{\text{Total fuel consumed (5)}}.$$

Cost of Pumping, figured on Pumping Station Expenses, viz, $00.00.

11. Per million gallons raised against dynamic head into { *a*. Reservoir. *b*. Tank. *c*. Stand Pipe. *d*. Direct.
12. Per million gallons raised one foot high (dynamic) .....

Cost of Pumping, figured on Total Maintenance, viz., $00.00.

13. Per million gallons raised against dynamic head into { *a*. Reservoir. *b*. Tank. *c*. Stand Pipe. *d*. Direct.
14. Per million gallons raised one foot high (dynamic) .....

FINANCIAL.

Receipts.

Division I.

FROM CONSUMERS:			
A.	Water rates, domestic,		$00 00
B.	" " manufacturing,		00 00
C.	Net receipts for water,		00 00
D.	Miscellaneous (rent, repairs, sales,)		00 00
E.	Total,		00 00
FROM PUBLIC FUNDS:			
F.	Hydrants,	00 00	
G.	Fountains,	00 00	
H.	Street watering,	00 00	
I.	Public buildings,	00 00	
J.	General appropriations,	00 00	00 00
K.	Gross receipts from all sources,		$00 00

Division II.

FROM FIXED RATES:	*L.*	Domestic,	$00 00
	M.	Manufacturing,	00 00
			00 00
FROM METER RATES:	*N.*		00 00
	O.	Domestic,	00 00
	P.	Manufacturing,	00 00
	Q.		$00 00

R.	From balance of previous year,	$00 00
S.	" bonds issued,	00 00
T.	" appropriations from tax levy,	00 00
U.	" other sources (services, private lines, meters, etc.,)	00 00
V.	Total,	$00 00

MAINTENANCE.

Expenditures.

AA.	Management and repairs,	$00 00
BB.	Interest on bonds,	00 00
CC.	Total maintenance for year,	00 00
DD.	Balance (where carried,)	00 00
EE.	Total,	00 00

CONSTRUCTION.

FF.	Extension mains,	$00 00
GG.	" services,	00 00
HH.	Special (reservoirs, pumps, etc.,)	00 00
II.	Total construction for year,	00 00
JJ.	Balance,	00 00
KK.	Total,	00 00

W. Net cost of works to date .....

X. Bonded debt at this date ..... *Z.* Rate of interest .....

Y. Value of sinking fund at this date .....

CONSUMPTION.

1. Estimated total population at date,
2. " population on lines of pipe at date,
3. " " supplied at date,
4. Total number gallons consumed for year,
5. Passed through domestic meters, galls. or per cent.
6. " " manufacturing " galls. or per cent.
7. Average daily consumption,
8. Gallons per day to each inhabitant (1),
9. " " " consumer (3),
10. " " " tap (Distribution, 22),

DISTRIBUTION.

MAINS.

1. Kind of pipe used,
2. Sizes from inch to inch.
3. Extended feet.
4. Discontinued feet.
5. Total now in use, miles.
6. Cost of repairs per mile,
7. No. of leaks per mile,
8. Small distribution pipes, less than 4 inches — total length,
9. Hydrants added,
10. Number now in use,
11. Stop gates added,
12. No. now in use,
13. Small stop gates — less than 4 inches — total,
14. No. of blow-off gates,
15. Range of pressure on mains at centre for day and night,

SERVICES.

16.
17. From inches to inches.
18. feet.
19. feet.
20. miles.
21. Service taps added,
22. Number now in use,
23. Average length of service,
24. " cost "
25. Meters added,
26. Number now in use,
    a. Domestic.
    b. Manufacturing.
27. Motors and elevators added,
28. Number now in use,

SPECIAL.

Remarks on page concerning
" " "
" " "

NOTES ON SUMMARY.

BE sure to state distinctly, on outside cover as well as here, the following items: Name of City or Town, State, and date of report.

Number all items in this summary to conform to the numbers adopted for this scheme, i. e., let "total fuel consumed for the year" always be "Pumping" (5.) Number of leaks per mile would be "Distribution" (7.)

PUMPING (8.)—The dynamic head is indicated by pressure guage at the pumping engine.

PUMPING (10.)—Only one formula on duty is here presented, viz., one giving the result from a purely commercial standpoint. It is hoped that for the sake of uniformity this formula will be strictly followed in this summary, leaving all other methods of presenting duty to be stated in the body of the report.

PUMPING (11, 12.)—The pumping station expenses for this statement are to include only the following:

1. Cost of fuel.
2. Salaries.
3. Oil, waste, and other supplies.
4. Repairing on machinery and boilers.

PUMPING (13, 14.)—Item "Financial *CC*," indicates the amount to be used in obtaining this result.

The cost of raising water per million gallons one foot high is stated "dynamic" rather than "static," because the latter is not always easily obtained in cases of "stand pipe" or "direct pumping."

CONSUMPTION (5, 6.)—A distinction is here made between domestic and manufacturing. Let manufacturing include only mills, and shops where water is used for making steam, or where it is an essential element of the process of manufacture. But when an establishment is once included in this class, take into account *all* the water used for *all* purposes.

FINANCIAL.—We would urge the importance of keeping in the "Summary," at least, a constant and clear distinction between items of maintenance and construction, without regard to the particular methods of book-keeping employed, and exhibited in the body of the report. It is not expected that every town will be able to give every item from *A* to *Q* inclusive, but it is thought that the grouping of items under the two heads, From Consumers, and From Public Funds, may be followed. Division II can be followed only by places having a considerable number of meters. Item *J* is to cover any and all appropriations from tax levy which in any way go to the water department, which are not covered by preceding or following items.

DISTRIBUTION (21, 22.)—When a main line is cut and a branch line with private gate is inserted, this is to be considered as a "service tap."

REPORT OF EXECUTIVE OFFICER.*

Here should follow as brief and comprehensive a statement of the year's work as it is possible to make, noting in general terms new work and special occurrences. Leave all details to be mentioned under the proper heads.

FINANCIAL.

This is the department where to suggest anything which can be uniformly acceptable, is most difficult, but in general we would urge that the plan outlined in the summary be followed, by expanding the items there given. For example, item *AA* may be subdivided into office expenses, superintendence, repairs on meters, on services, on mains, or on reservoir, according to the particular case on hand.

SOURCE AND SUPPLY.

Under this head the following topics and statistics are suggested: —

I. Quantity and quality, noting changes in either, and the known or supposed causes thereof.

II. Chemical analyses, — at source, at reservoir, and at faucets.

III. Remarks upon any filtering appliances or processes that have been tried, including analyses before and after filtration.

IV. Records of temperatures at source, reservoir, in mains, and at faucets.

V. Recommendations as to methods for increasing and improving the supply.

* NOTE. — The exact order in which the topics are here treated is of course not essential, but must be determined by the special conditions governing each case.

PUMPING STATION.

Here should be given the minor details which would be too numerous to embody in the summary. A carefully prepared statement of engine and boiler performance, which should cover as many of the following points as may be practicable in each case.

BOILERS.

1. Type, number, size, and setting.
2. Grate area in square feet.
3. Heating surface in square feet.
4. Steam pressure carried.
5. Temperature of feed-water.
6. Water evaporated per pound of coal in pounds.
7. Kind of coal used.
8. Where mined.
9. Price per ton.
10. Other steam fuel { Quantity. / Price.

ENGINES AND PUMPS.

11. Type, number, power, and capacity.
12. Capacity of pumps per revolution.
    (*a*. Figured on theoretical displacement. *b*. As used in calculating duty.)
13. Static head on pumps.
14. Dynamic head on pumps by gauge.
15. Number days pumping.
16. Total pumping time.
17. Average pumping time per day.
18. Total number of gallons pumped for year.
19. Average number gallons pumped per day.
20. Pounds of coal consumed for year.
21. Engine duty in foot-pounds per 100 pounds of coal.

22.	Cost of fuel used,	$00 00
23.	Wages of engineers and firemen,	00 00
24.	Cost of oil, waste, and other supplies,	00 00
25.	Repairs on machinery and boilers,	00 00
26.	Total pumping expense,	$00 00

27. Cuts of indicator cards from engines and pumps.

DISTRIBUTION AND CONSUMPTION.

Remarks as to the general condition of the distributing system, including opinions as to the value of different materials and appliances.

The tables suggested by Messrs. Croes and Price, viz.:

Monthly Consumption and Pressure in Business Part of the Town.

Month.	Gallons, Daily Average.	Pounds pressure at 10 A. M.			Pounds pressure at Midnight.		
		Max.	Min.	Average.	Max.	Min.	Average.
January,							
February,							
March,							
April,							
May,							
June,							
July,							
August,							
September,							
October,							
November,							
December,							
Averages,							

Statements as to methods employed and results obtained in suppressing waste, including the use of meters.

GENERAL DISCUSSION.

Present here topics not already classified.

Accounts of special experiments.

Illustrate, by cut sand diagrams, any device, tool or appliance that has been successfully used in any direction. Let the full statistical tables here follow as nearly as possible in the following order: —

A. Meteorological observations.
B. Performance of engines.
C. Sizes and number of meters and motors in use.
D. Location and sizes of mains.
E. " " " stop gates.
F. " " " hydrants.
G. " " " waste gates.
H. Statement of work done by service department.

Mr. BILLINGS. These diagrams speak for themselves, and I shall have but a little to say. They simply show what use can be made of statistics when they are gathered according to the plan which we have the pleasure of presenting to you. We do not suppose we have covered every single item and every combination of items that every man will want, but we do think we have provided for enough of the fundamental items to make any combination possible. We urge strongly the importance of retaining all the numbers. If a city or town cannot fill out every number, it is important to preserve the uniform numbering of all the items which are given. The financial statements are, perhaps, the ones with which comparisons are oftenest made, for it is largely the matter of cost that we all want to study. As appears by this diagram, New Bedford could not give certain items, owing to their method of keeping the accounts.

PUMPING.

	TAUNTON.		NEW BEDFORD.	
1	Holley Mfg. Co.	1	Quintard Iron Works. Henry R. Worthington.	
2	*a*—Anthracite. *c*—Egg. *d*—Haselton. *e*—$5.44 *f*—13 per cent.	2	*a*—Anthracite. *c*—Broken. *d*—Phil., Reading free white ash. *e*—$4.85 *f*—13 per cent. *g*—$4.00	
			McAlpine.	Worthington.
3	718.600	3	1,842,300	355,700
4		4	84,960	19,470
5	718.600	5	1,927,260	375,170
6	218,701,174	6	747,130,741	117,762,912
7		7	123.5	123
8	127.05	8	138.5	128
9	304.	9	$405\frac{54}{100}$	$331\frac{7}{100}$
10	32,000,000	10	44,778,766	33,508,613
			Into reservoir.	
11	Direct, $22.56	11	$10.77	$14.88
12	$0.17\frac{1}{10}$	12	$0.07\frac{77}{100}$	$0.11\frac{68}{100}$
13	$168.73	13	$91.30	
14	$1.32	14	Static,	$.73\frac{22}{100}$

MAINTENANCE.

RECEIPTS — DIVISION I.

	TAUNTON.		NEW BEDFORD.		
A.	23,782.61		32,813.72		A.
B.	6,893.30		3,860.50		B.
C.	30,675.91		36,674.22		C.
D.	none		222.08		D.
E.	30,675.91		36,896.30		E.
F.	7,000.00				F.
G.	924.61			12,000.00	G.
H.	300.00				H.
I.	400.00				I.
J.	none				
	8,624.61		70,300.00	58,300.00	J.
K.	39,300.52		107,196.30		K.

EXPENDITURES.

	TAUNTON.		NEW BEDFORD.	
AA.	14,618.82		20,665.06	AA.
BB.	22,283.89	Int.,	48,000.00	BB.
		Prin.,	10,000.00	
CC.	36,902.71		78,965.06	CC.
DD.	2,397.81		28,231.24	DD.
EE.	$39,300.52		107,196.30	EE.

RECEIPTS — DIVISION II.

TAUNTON.		NEW BEDFORD.	
Fixed Rates	L—17,120.80	All fixed rates	L.
	M— 454.00		M.
	N—17,574 80		N.
Meter Rates	O— 6,907,81		O.
	P— 6,893.30		P.
	Q—$31,375.91		Q.

CONSTRUCTION.

	TAUNTON.		NEW BEDFORD.	
R.	7,291.94		7,130 14	R.
S.	12,000.00		100,000.00	S.
T.	1.563.98		none	T.
U.	4,859.60		5,623.08	U.
V.	25,715.52		112,753.22	V.
W.	472,312.89			
X.	450,000.00			
Y.	107,315.62			
Z.	4—4½—6			

	TAUNTON.		NEW BEDFORD.	
FF.	2,802.16		14,716.38	FF.
GG.	5,063 10		5,489.71	GG.
HH.	11,834.15		59,917.04	HH.
II.	19,699.41		80,123.13	II.
JJ.	6,016,11		32,630.09	JJ.
KK.	$25,715.52		112,753.22	KK.

CONSUMPTION.

	TAUNTON.	NEW BEDFORD.	
1	22,000	33,000	1
2	19,500	. . .	2
3	16,000	23,749	3
4	218,701.174	867,815,595	4
5	22,368,885 or 10 per ct.	. . .	5
6	53,674,875 or 24 per ct.	. . .	6
7	599,208	2,371,080	7
8	27	72	8
9	37	100	9
10	247	506	10

DISTRIBUTION.

	TAUNTON.	NEW BEDFORD.	
1	Cast iron	Cast iron, and wrought iron cement lined	1
2	4 to 20 inch	4 to 30 inch	2
3	305 feet	12,119 feet	3
4	. . .	673 feet	4
5	47.4 miles	48.5758 miles	5
6	$22.10	6.57	6
7	3 for the year	18 for the year	7
8	2,938 feet	1.093 miles	8
9	6	20	9
10	414	352	10
11	2	35	11
12	266	445	12
13	4	35	13
14	16	36	14
15	55 lbs.	30 to 35½ lbs.	15
16	Wrought iron cement lined	Lead and cast iron	16
17	3-4 to 6 inch	½ to 8 inch	17
18	6,340 feet	6,847 feet	18
19	. . .	. . .	19
20	22.6 miles	. . .	20
21	133	228	21
22	2,422	4,691	22
23	47.7	29.6	23
24	$14.18	$19.34	24
25	63	11	25
26	*a*—417 *b*— 50	*a*—35 *b*—25	26
27	none	. . .	27
28	3	25	28

But it is expected that each city or town will give what items are best suited to its own methods, and fill out the numbers as far as possible. This is supposed to be a sort of summary, and special matters of detail can be covered in the body of the report. Without such a summary, it is impossible to make satisfactory comparisons. Let me suggest the importance of keeping a distinction between items of maintenance and construction. The practice of applying water rates to extensions brings in great confusion when one tries to make financial comparisons. I would simply throw out the suggestion that water rates ought not to be applied directly to extensions. They should be applied to the sinking fund, and then the money borrowed from the sinking fund and bonded. I don't know as any particular suggestion occurs to me now in regard to these diagrams, but I can answer any question any one chooses to ask regarding them.

The section in which there is the greatest diversity of practice is that covered by "Items Financial" from F. to J. This shows only one of the combinations that may be made. We intended to cover in these items all the appropriations that come from the tax levy, and the headings which we have used, such as "Fountains,' "Street Sprinkling," and one thing and another, we don't expect to be followed precisely nor exactly, but what we do wish is to have public funds kept entirely separate and distinct from private water rates. You can let your bookkeeper make such division from F to J as his particular case demands.

The PRESIDENT. If it cannot be divided otherwise, it can be put under the head of J.

Mr. BILLINGS. Yes, if there is no better way to do it.

Mr. HATHAWAY:

It is a recognized fact to those who have been familiar with the subject, that it would be impossible to make up from the various water reports as they are now presented a comparative statement that would be in any way satisfactory. To illustrate, Mr. Coggeshall and myself were called upon by our committee on water supply to make up a summary setting forth the cost, the management and repairs, bonded debt, sinking funds, etc., of each of the water works of Massachusetts. After scanning carefully the reports in our possesion, we found that it would be impossible for us to give to the committee the required statement; not that results were in any way concealed, the trouble seemed to come from the variety of methods employed in making up the reports of the various water departments. Of the 1008 cities and towns in the country having a water supply, probably no two of the number employ like methods of book-keeping; that being the case, of course the reports must differ somewhat in detail, many not giving the actual cost and in but a few cases was it possible to learn what had been paid in general taxation towards the construction of the works, etc., and in some cases reports did not show the amount paid by cities and towns for the use of water for public purposes.

I think it would be of great help to us all if we could incorporate in our yearly reports a uniform statement, and I know of no better form than the one just explained to us.

As I understand the case, no one will be required to change the manner of making reports; just add to it a new page.

Mr. WILCOX. The thought has occurred to me, why do we have these reports? In the first place the public, the city or town which has the water works, expects to know what it costs to run them. That is the initial starting point.

Now, each one of the water works represented here makes an annual report. Eight years ago, when I commenced on the Waltham water works, I found a pile of the old reports up in the garret. I asked why so many had been printed; and I was told it was intended that each tax-payer could have one if he wanted it and would call for it. I asked permission to distribute them, and to send them out to other water works. They said very well, I might do so. I have sent out each year, since, three or four hundred copies to as many different departments. Usually about one-third of them are answered. But in comparing the reports that I get in exchange, I find I can look through some of them and ascertain just exactly what they have been doing, and what it cost for each department of the water works; what it cost for the salaries of the engineers, what it cost for the salary of the superintendent, what it cost to raise the water into the reservoir, what it cost a gallon to pump the water that was used. In other reports I couldn't learn anything. I couldn't tell what the salaries were or anything else; there were simply a lot of words strung together without giving any information.

Now, it seems to me, if we can have a uniformity, if we can have some outline by which to make up these reports, it will make them a good deal more interesting and satisfactory. The outline which is given us in this little pamphlet will enable those who have not given the subject much attention, by following this as a guide, to put more information into their reports than they have been accustomed to do.

Then there is another idea in the uniformity of the reports,—it will bring out a rivalry Each superintendent will want to outdo the other superintendents. He will want to run his works as cheap as any one else; and it will be the same with the commissioners, the managers of the works,

and they will want to make a good showing, and consequently, will be more likely to look after the general detail of the business. The commissioners will look closer to the superintendent, the superintendent will look closer to his men, and there will be a tendency to more economy in running the works. And, then, the general public will not have so much to pay if the works are run as cheaply as they can be.

These are the thoughts that came to me when I was asked to make a few remarks on this subject to-day. I am very much pleased with the report as given by Mr. Coggeshall. I think he has illustrated the subject very finely.

Mr. SHERMAN. I think Mr. Wilcox has struck the keynote of the argument in favor of having these reports uniform. I have always maintained, and I can't see why it cannot be done, although I know it is not, that water works should be conducted on business principles, just the same as anything else. A city or town has got a merchantable article to sell. Of course, there is no competition, but still, every taxpayer is a stockholder in the corporation, and is entitled to know what the condition of the corporation is. But, as the reports are made to-day, it is impossible to draw a comparison between any two works with any degree of certainty. There is always ambiguity about it which leaves a doubt as to whether your comparison is correct or not. Those who manage mills have what they call a "monthly sheet" drawn up. Everything is arranged according to the cost per pound of product. Labor costs so much per pound of product; oil costs so much, and the running expenses outside of the material cost so much. Of course the directors in one corporation are often more or less interested in others, and they draw their comparisons between one and the other to see where one is making and where another is losing. Now, in this matter of water supply, some comparison can be drawn

and ought to be drawn, which, as Mr. Wilcox suggests, would incite not only the superintendents, who are merely the executive officers, but the commissioners who are back of them, to fix the rates wisely and work the thing economically.

The SECRETARY. I fully agree with the gentlemen who have spoken as to the very great importance of this subject; and I think the gentlemen who have prepared this report have placed the members of the Association under very great obligations to them for the very careful manner in which the work has been performed. I would move that in the preparation of annual reports for the present year, the members of the Association, as far as is in their power, follow the plan recommended by Messrs. Coggeshall and Billings.

The motion was adopted unanimously.

Mr. NOYES. I would suggest that possibly the item AA under expenditures might, if convenient, be given a little more in detail, as to salaries and the character of repairs, and something of that sort. There are many works which class under construction what others consider as repairs, and for the sake of comparison, it would be better if we had that item a little more in detail.

The PRESIDENT. As I understand it, the recommendation of the committee is that such a division as you suggest be made in the body of the report, while this should be made as a summary.

Mr. COGGESHALL. That is the idea.

The PRESIDENT. This summary is to be given without regard to what is in the body of the report, so we will only have to compare three pages of the reports and find it all boiled down.

The SECRETARY. One other suggestion, and that is, I think it would be very desirable if the reports could be uniform in size, so they could be filed readily. I simply throw

that out as a suggestion; of course it is not necessary to take any action upon it.

Mr. CHASE. It is the general custom of private companies not to furnish reports. Whether I should consider it worth the while to publish them at my own expense, I can't say; but I would esteem it a favor if the various members of the Association would remember me with their reports when they come out, as a great many of them have; and I should be very glad to acknowledge the receipt of them by letter if not by report.

The PRESIDENT. Three pages of this summary, which would furnish all this material for comparison, would be of interest to yourself and your associates.

Mr. CHASE. I think I can guarantee to furnish that, but you understand the relations most private companies have with the municipalities. There are certain financial matters they don't like to have in print (laughter.) There may be some facts, however, which I can furnish the data upon.

Mr. JOY. Mr. Chase has explained the position I am in. I represent some private companies, and we try to get all out of the towns we can, pretending that we are not making any money, etc. If we should publish our reports in an itemized form, as is here suggested, which we never have done, it would give the cities and towns a chance to know what we are doing as private business. And although a great many of my friends have favored me with their reports, for which I am very grateful,—and I have shown them to my directors and we have studied them,—I cannot say that I can reciprocate, because we do not like to show to the cities or to the world, perhaps, our financial standing, or whether we are making or losing. We show it to our directors and to our stockholders privately, but further than that, we do not care to have the public know.

The PRESIDENT. I don't suppose the members of the Association would like to have these parties who represent private companies have our reports and then say, "what fools those folks, who are working for the public, are." [Laughter.]

Mr. HOWLAND. There is one other point in connection with the management of water works which has not been touched upon by the Association, and concerning which I should like to say a word, and that is a uniformity of classification of water rates. We build works, either as a town or city, for the general benefit of the people; but we look to a revenue from our water rates to reimburse us either for the whole or part, certainly to meet our interest and running expenses, and it is a great question as to how the rates shall be classified. I have had occasion during the past two years to pass upon the establishment of rates for several different places, and I find I am hampered by different customs in different localities. I cannot establish at present, without running in the face of everybody, a uniform classification. I find some classify according to the value of the property, others according to the number of occupants in a house, others according to the number of rooms in a house; that is, for the first family rate, faucet rate. After that there is a certain general uniformity in relation to additional fixtures.

I would move you, Mr. Chairman, that the chair appoint a committee of three to take this matter into consideration, and report at the next annual meeting a uniform method of classification.

I do not wish to be understood that we want a uniform system of rates, because the circumstances in different places are different. We cannot afford to sell water as cheap in one place as we can in another; but we can have uniformity of classification, and, therefore, I have made the motion which I have.

The SECRETARY. I fully approve of the suggestion of the gentleman. And this has brought out a point which was in my mind, and which I had been meaning to speak on before the convention adjourned, and that is with regard to water rates, a classification and compilation of them for different places. There has been floating around in the newspapers for the last five or six years a comparison of the water rates for certain purposes fixed by different places. I have seen it, possibly, a half a dozen times, printed in various reports and in different newspapers. It seems to me something ought to be done to stop the circulation of that, for a good many things in it are wrong. Certainly the rates as fixed for Newton by the statement are very incorrect. I approve of the suggestion of the gentleman, and second his motion.

The motion was adopted, and the president appointed Messrs. Howland, Hathaway and Glover as the committee.

Mr. PARKER. Under the head of "Pumping," in the form of report suggested by the committee, I find the only items are coal and wood by the cord. Now, I happen to come from a town which is engaged in dressing lumber, and we use shavings about ten months in the year. I should like to know how I can make a comparison between coal and shavings.

The PRESIDENT. You would have to make a statement of the fact in the report, and that would enable a man to see the special circumstances under which you were situated. Of course, it would give you a nominal advantage.

Mr. PARKER. The shavings are lumped at so much a week, generally, and the market price would depend on how the lumber business is, a rather uncertain factor.

Mr. NOYES. An examination of the report shows that there must have been, on the part of the gentlemen compiling it, a very great amount of work, involving careful study

and considerable correspondence. In addition to that, there must have been a very considerable expense incurred in publishing the report in such numbers that we could all receive a copy. I believe it is unfair to ask our committees not only to put their labor into work of this kind, but also to bear the expense. I believe the benefit the Association will receive will more than equal the expense, and I think it would be perfectly proper for the Association to reimburse the gentlemen compiling the report for the amount of the expense they have been put to in the compilation. I would make such a motion.

The motion was seconded by Mr. Joy and was adopted.

Mr. NOYES. I may say still further, in this same line, that probably many topics will be assigned to members for discussion, which will require a very considerable amount of correspondence and entail some considerable expense. It seems to me we have arrived at that point, financially, where, if the individual members are willing to put in their labor, the actual expense should be borne by the Association. I make that as a motion, and that the matter be left in the hands of the executive committee. Adopted.

Mr. CHASE. One other topic. It seems to me that the programme of the meeting has been rather long. There have been five papers, and the discussion has been lively and full; but we don't seem to have got down to the bottom of anything. Certainly we have not on the street main question, and I don't know what disposition is to be made of that. I was querying whether it would not be better to limit the number of papers and so give time for further discussion. I consider that the value of the meetings of the Association comes, not from the papers, particularly, nor entirely from the discussion, but from what you might call the attrition, the meeting and talking outside. I just throw that out as a

suggestion to the Executive Committee, to reduce the number a little another year, and give more time to finish them up. There is a possibility, also, going on at such a rate as we have, five papers a year, that we may run a little short of topics one of these years.

The PRESIDENT. That is a matter which is in the province of the Executive Committee. But I imagine, as we know each other better and become older, that instead of the number of topics growing fewer, or we finding less to talk about, we will find more and more. I should hope we would always have enough of interest, and that if we could not finish it up in two days we would take the third day.

Mr. SHERMAN. As this is the last time, probably, we shall be together in this meeting in a formal way, I should like to speak upon a subject in which I am interested, even at the risk of being wearisome, and that is the matter of the sketches. I am well pleased with the success at this meeting. Twelve or thirteen, I think, have been presented, a sufficient number, I am satisfied, to prove to you, one and all, the advantages in the interchange of work in this way. Now, this was not started to be for this one year only, it was not intended to be a transitory thing, in any way, shape or fashion, but a permanent institution; and next year I hope to see on the table, instead of 12 or 13, a pile about two feet high (laughter and applause), containing 50 or 60 sketches; and I will defy any man to find a more meaty book than those 50 or 60 pages will make when bound. (Applause.) I hope this will go on increasing from year to year, and I think it will be of great benefit to the Association. You gentlemen who have contributed this year, I thank most heartily for your cooperation. I have made a little sketch, on one of my prints, of a blue print process, with frame for

taking off; and that can be reduced so that any of you can do it. I think in the case of those who are so situated that they cannot make copies, if they will furnish negatives from which copies can be taken, facilities can be afforded so that there will be no excuse for any one not presenting at least one subject in sketch form.

The PRESIDENT. I think the Association will have to confess that it has no more enthusiastic member than the gentleman who has just taken his seat. (Applause.) It was his own magnetic remarks that started this thing last year. The success, I think, has surprised every one, and, on behalf of the Association, I thank Mr. Sherman. (Applause.)

Mr. BILLINGS. If I may be allowed just a moment, for I do not want to let the opportunity slip, not as a mere matter of form, but as a matter of genuine satisfaction and pleasure which we all feel in the administration of the past year, I will ask the secretary to put this motion: That the most hearty thanks of the Association be returned to the retiring president for his faithful and enthusiastic work for the Association. (Applause.)

The motion was put by the Secretary and adopted by a rising vote.

The PRESIDENT. Gentlemen: I can say but one or two things to you. The first one is, if you are satisfied, I assure you most heartily I am. (Applause and laughter.) It has given me great pleasure to preside over your deliberations the past year and to act as your president. I have received from you most hearty cooperation upon every occasion when we have been together. I believe that there is a great future before the New England Association, but with all that is before it, I feel that it will be a long time before any of my successors will have an opportunity to witness a greater growth or meet with you in more earnest

meetings, or find the same opportunities which you have given me the past year. Most heartily I thank you for your kindness. And now allow me to present to you your president-elect, Mr. Coggeshall of New Bedford. (Applause.)

Mr. COGGESHALL. Gentlemen: It is with some degree of embarrassment that I have accepted your command. I feel that you could easily have bestowed the mantle of my worthy predecessors on one more capable than I. We all know that our society has grown to such a magnitude that it now ranks, certainly, I think, the first in the land. (Applause.) I will not take up your time by any extended remarks, but will merely assure you, gentlemen, that I fully appreciate the honor you have bestowed upon me. [Applause.]

Mr. Ellis moved the convention adjourn. Adopted.

EXPERIMENTS SHOWING DISCHARGE THROUGH HOSE.

Immediately after adjournment, at the invitation of Chief A. P. Leshure, of the Springfield Fire Department, the Association proceeded to Pynchon street, where the following experiments were made from a "Chapman four-way independent valve hydrant."

The pressure at the hydrant being observed from still water, while that at the nozzle was subject to a loss of head equal to that required to produce the velocity of water flowing through the 2 1-2 inch coupling.

The small hose used was fifty feet in length and was one inch rubber lined. The large hose was in three hundred feet lines, and was rubber lined fabric hose.

No. of Experiment.	Pressure Maintained at Hydrant.	No. of lines of Hose.	Size of Hose.	Form of Nozzle.	Size of Nozzle.	Observed Pressure at Nozzle.
1	100 lbs.	1	1 inch.	Smooth.	¼ inch.	93 lbs.
2	100 "	1	1 "	"	½ "	60 "
3	90 "	1	2½ "	"	1¼ "	32½ "
4	90 "	1	2½ "	Ring.	1½ "	42½ "
5	90 "	1	2½ "	Smooth.	1½ "	42½ "
7	90 "	1	2½ "	Ring.	1½ "	26 "
6	90 "	1	2½ "	Smooth.	1½ "	20 "
8	90 "	2	2½ "	"	1½ "	42½ "
9	90 "	3	2½ "	"	1½ "	56 "
10	90 " Hammer.	1	2½ "	Heley Shut off.	1 "	81 "
" Shut off.	120	1	2½ "		1 "	125 "
" "	120	1	2½ "		1 "	130 "
" "	125	1	2½ "	"	1 "	135 "
11	90 Hammer.	1	2½ "		1 "	60 "
Shut off.	115	1	2½ "		1 "	160 "

COMPLIMENTARY DINNER.

At the conclusion of the tests made by Chief Leshure, the Association was tendered a dinner at the Massasoit House by citizens of Springfield. About seventy-five persons gathered around the tables, among the prominent Springfield men present being Water Commissioners Sanderson and Fisk, City Engineer Ellis, Supt. Hancock, Chief Leshure, President Long of the Common Council, ex-Mayor Powers, Hon. H. S. Hyde, James D. Safford, Esq., and Jason Giles, Esq. Upon calling the assemblage to order, after the dinner had been sufficiently discussed, brief remarks were made by Commissioner Sanderson, who presided, President Coggeshall, President Long, President Cate of the Newton Water Board, Hon. H. S. Hyde, Superintendent Billings, Mr. J. D. Safford, William B. Sherman, of the Corliss Engine Co., H. B. Blake, Esq., ex-President Ellis, and Secretary Glover; then, after passing a vote of thanks to the Water Board and citizens of Springfield for their generous hospitality, the meeting adjourned, and the Association immediately took a special train, as guests of the Chapman Valve Manufacturing Co., for a trip to Indian Orchard, where the large and well-appointed establishment of the company was inspected to the manifest interest and instruction of the members; returning from Indian Orchard, the Association was tendered and accepted a further courtesy of the company in the form of a lunch at the Massasoit House, and then separated to depart for their homes.

ALBERT S. GLOVER,
Secretary.

WEIGHTS OF CAST IRON PIPE.

The weight of cast-iron pipe for all sizes and pressures, deduced from pipes in services; to be ascertained by correspondence and shown by diagram.

PAPER BY ALBERT F. NOYES, C. E.

Mr. President: —

The consideration of this subject was so ably and fully presented in a paper read by A. H. Howland, Esq , a member of this Association, at the Convention of the American Water Works Association, held in Boston in April of this year, at which meeting most of our members were present, that the thoughts or suggestions I may be able to present can only be considered as supplementary to or a duplication of said paper.

As Mr. Howland's correspondence extended to the Superintendents or Engineers of nearly all of the Water Works of the United States and Canada, I have through his courtesy availed myself of their use, and whatever deductions or conclusions which have been arrived at have been from them, and the practice as set forth in the text-books and papers read before technical societies upon the subject.

Answers from the officials of one hundred and sixty-nine works giving information as to their practice in the use of cast-iron pipe were received.

A comparison of the weights of the various sizes of pipes in use under similar pressures and conditions, as far as could be deduced from said correspondence, showed a great variation in practice, conforming, as far as I have been able to judge, to no general law.

The weight of one size in use in one works under apparently the same conditions and maximum pressure may greatly exceed that of the same size in other works, while the reverse may be the case in the other sizes. I have been unable to

Statistics of t

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Weight of Pipe in lbs. per foot.

Pressure.	Place.	State.	Miles.	System.	Date of Construction.	Population.
20	Denver.	Col.	43.	D.	1872.	75.000.
	New Orleans.	La.	70k.	D.T.P.	1833.	230.000.
21.	New Bedford.	Mass.	39k.	P.	1866.	33.000.
	Oakland.	Cal.	123.	P.	1866.	40,000.
22.	Harvey Foundry.	N.J.	-	-	-	
30.	Baltimore.	Md.	14k.	P.	1877.	14.000.
	New Brunswick.	N.J.	1	R.	1866.	18.300.
32.	Fremont.	Pa.	2	G.	-	2.200.
35.	Bridgeton.	N.J.	14k.	P.	1877.	11.000.
36.	Macop.	Ga.	165.	P.	1881.	15.000.
	Elmira.	N.Y.	40.	G.P.	1861.	28.400.
	Bridgeton.	Del.	14k.		1877.	11.000.
40.	Northampton.	Mass.	25.	G.P.	1877.	13.200.
	Rochelle.	Ill.	12.		1871.	2.000.
	Trenton.	N.J.	40.	P.	1803. 1853.	30.000.
41.	Los Angeles.	Cal.	28.	P.	1862.	31.000.
43.	Marlboro.	Mass.	-	D.T.P.	1863.	10.500.
	Middlebury.	Conn.	2k.	G.P.	1866.	10.000.
	New Brunswick.	N.J.	1.		1866.	18.300.
	Pawtucket.	R.I.	10m.	D.T.P.	1772. 1870.	120.000.
43½	Oakland.	Cal.	123.	P.	1866.	40.000.
46.	York.	Pa.	10k.	P.	1816.	16.000.
48.	Detroit.	Mich.	177.	P.	1827.	152.300.
50.	Gorham.	N.H.	2.	G.P.R.	1873.	1,500.
	Lancaster.	Pa.	2k.		1869.	1,400.
	Allentown.	Pa.	17.		1867.	12.000.
54.	Chicago.	Ill.	384.	P.	1853.	630.000.
58.	New Brunswick.	N.J.	1.	P.	1865.	15.300.
	Wilmington.	Del.	55.	P.	1827. 1872.	50.000.
	Evansville.	Ind.	32k.	D.	1870.	45.000.
60.	Freeburg.	Pa.	4k.	G.	1862.	1,500.
	Lansing.	Mi.	6.	D.T.P.	1872.	10.000.
	Georgetown.	N.Y.	30.		1868.	25.000.
	Stonebville.	N.J.	7.	P.	1882.	6.000.
62.	Yarmouth.	N.S.	18.	D.T.P.	1851.	64.000.
	Lewisburgh.	Pa.	4.	P.	1863.	5.000.
	Kenosha.	Wis.	3k.	G.	1879.	7.000.
66.	Meadville.	Penn.		D.T.P.	1861.	10.500.
	Oakland.	Cal.	123.	P.	1866.	40.000.
	Rutland.	Vt.	15.	G.	1856.	9.000.
66.	Holyoke.	Mass.	3k.	G.	1873.	30.000.
	New Bedford.	Mass.	39k.	P.	1865.	33.000.
70.	Cornersville.	N.Y.	8.	P.	1854.	6.000.
	Keene.	N.H.	26.	G.	1868.	7.000.
	Memphis.	Tenn.	42.	R.	1872.	90.000.
71.	St. John.	N.B.	46.	G.	1836. 1849.	38.600.
	Syracuse.	N.Y.		G.P.	1828.	64.000.
74.	New Castle.	Pa.	14.	P.	1881.	8.000.
75.	Danville.	Ill.	14.	P.	1883.	15.000.
77½	Providence.	R.I.	184.	D.T.P.	1772. 1872.	120.000.
	St. Louis.	Mo.	245.	P.	1833. 67. 73.	400.000.
	Boonville.	Mo.	6.	R.	1883.	4.000.
	Chambersburg.	Pa.	7k.	R.	-	4.000.
	East Saginaw.	Mich.	20.	R.	1873.	6.000.
	Manchester.	N.H.	15.	R.	1872.	30.000.
	New Bedford.	Pa.	1k.	R.	1883.	36.000.
						1.000.
80.	New York.	N.Y.	552.	G.	1842 to date.	1.400.000.
	Palestine.	Tex.	0.	P.D.	1881-2.	7.000.
	Paris.	Ont.	4.		1883-4.	13.500.
	Portland.	Me.	33½	G.R.	1869.	35.000.
	Richmond.	Va.	6k.		1831.	80.000.
	Wellsboro.	Penn.	5½.	D.T.P.	1872-3.	14.453.
83.	Phoenixville.	Pa.	11.	P.	1872-3.	7.500.
	Hamilton.	O.	26½.	R.	1883-5.	16.000.
85.	Newark.	N.J.	146k.	R.R.R.	1867-9.	152.000.
	Princeton.	N.J.	9.		1852.	3.000.
	Sayre.	Pa.	7.		1884.	2.500.

of the weights of Cast Iron Pipe
— in practical use —
and the
weight deduced from various formulae.

Compiled by —
Albert F. Noyes, City Engineer, West Newton Mass.
Member of N.E. Water Works Association.

*1.

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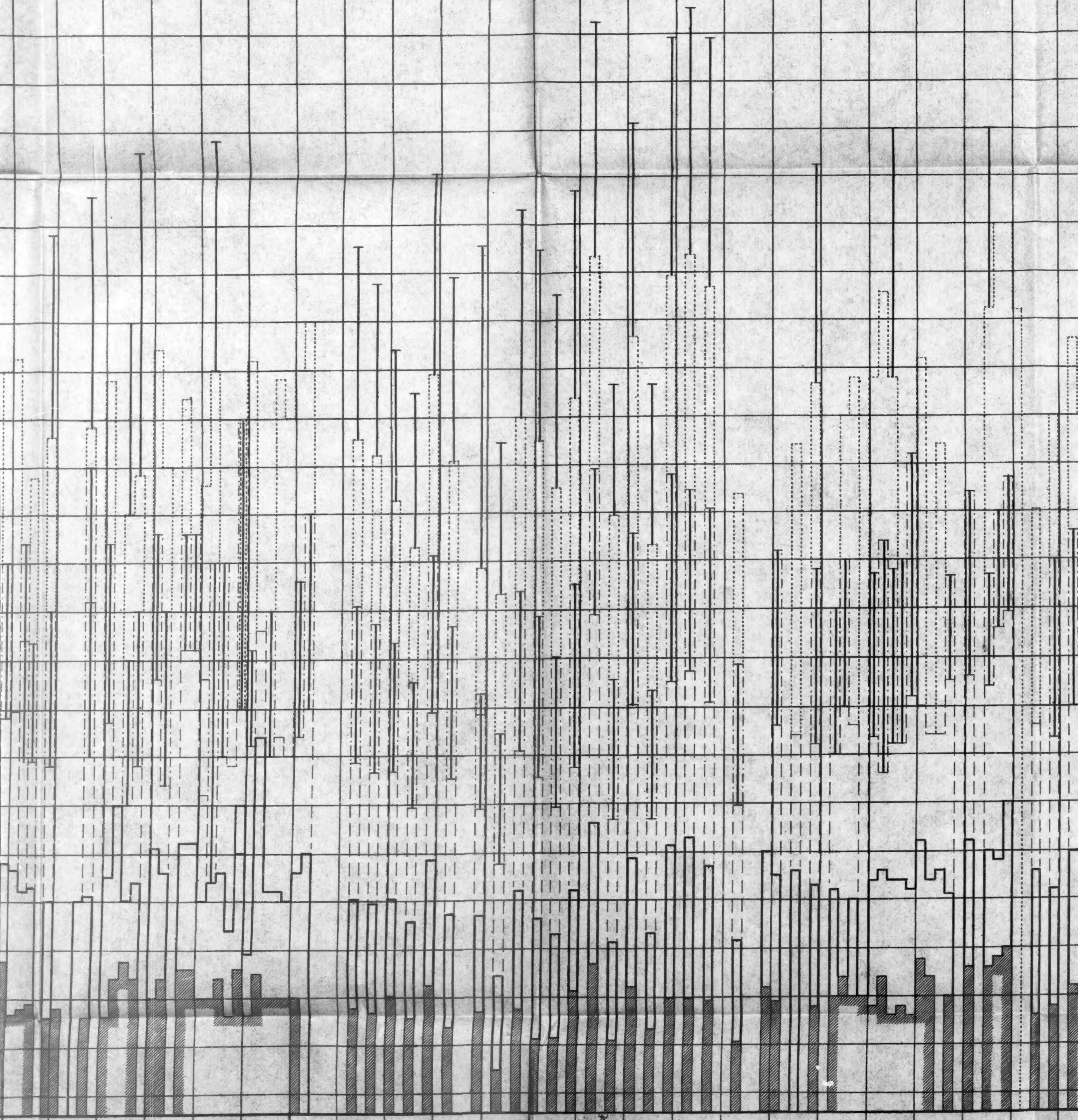


No.	Place	State			Year	Population
85.	Newark,	N.J.	146½	R.	1867-9	152.000.
	Princeton,	N.J.	3	R.	1882.	3.000.
	Sayre.	Pa.	7	R.	1884.	2.500.
86.5	[illegible]	Mass.		D.I.P.	1883.	10.500.
	Middletown.	Conn.	2½	B.	1866.	10.000.
87.	Dennison,	Ia.	3½	B.	1883.	2.500.
	Oakland.	Cal.	123.	R.	1866.	40.000.
	Burlington,	N.J.	8.	P. D.	1878.	7.500.
	Geneseo,	Ill.	3	R.	1882.	3.500.
90.	Hannibal,	Mo.	13.7	R.	1879.	15.000.
	Jamestown,	N.Y.	14.	D.	1882.	12.000.
93.	Holyoke,	Mass.	34.	B.	1873.	30.000.
	Salt Lake City,	U.T.	14.	B.	1873.	25.000.
	Cedar Rapids,	Ia.	13	D.	1876.	2.000.
	Durango.	Col.	3	R.	1882-4	3.000.
	Fredonia,	N.Y.	9½	B.	1884.	3.000.
	Gorham,	N.H.	2	B.	1883.	1.500.
	Macon,	Ga.	15.6	R.	1881-3.	1.500.
	Nantucket,	Mass.	6.6	B. I.P.	1878-82.	3.727.
	Owensboro.	Ky.	5	D.	1878.	12.000.
	Peterborough,	Ont.	4.	D.	1882.	8.000.
	Richfield Springs,	N.Y.	3.	B.	1879.	2.000.
	Richhill.	Mo.	9.	B.	1883.	5.000.
	So. Norwalk.	Conn.	13.	B.	1875.	5.000.
	Stratford.	Ont.	4½	D.	1883.	8.980.
	Washington,	D.C.	180.	B.	1859.	180.000.
	Minneapolis.	Minn.	45.	D.	1867.	100.000.

Weight of pipe per foot as deduced from different formulae:

No.	Authority	Formula	Notes
	Fanning J.T.	$t = \left(\frac{p+100 h}{4.5}\right) + .333\left(1-\frac{d}{100}\right)$	
	M. Dupuit,	$t = (.0016\, nd) + .013\, d + .32$	
	J.P. Kirkwood,	$t = (.015\, d) + .395$	
	Julius Weisbach,	$t = (.00238\, nd) + .34$	
	Benjamin Latrobe	$t = (.02\, d) + .18$	
100.	Thomas Box,	$t = \left(\frac{\sqrt{d}}{16} + .15\right) + \frac{hd}{2500}$	
	G.L. Mainwaring	$t = (.00008\, hd) + \frac{d}{...}$ for 4" to 12"; 12" · 30" · 50"	r = radius
	Wm. J. McAlpine,	$t = \sqrt{\frac{d}{48}}$	t = thickness of pipe in inches.
	John Neville.	$t = .0016\,(n+10)\,d + .32$	d = diameter
	Wm. [illegible],	$t = [illegible]$	h = head of water in feet.
	Baldwin Latham	$t = \frac{whd}{2s} + .25$	w = 62.5 lbs.
	James B. Francis	$t = (.0000\ldots hd) + .0152\, d + .312$	n = atmospheres of 33 ft. each.
	Thos. J. Whitman,	$t = (.0045\, nd) + .4 - .011 d$	p = pressure in lbs. per sq. inch
	M.C. Meigs,	$t = (.0260 + .15\, d) + .25$	S = 18000 lbs.
	J.H. Shedd,	$t = (.000\ldots\, hd) + .018\, d + .38$	
	J.F. Ward,	$t = (.0003\, hd) + .30$	
	Wm. P. Davis	$t = (.00\ldots\, hd) + .30$	
		$t = (.00018\, hd) + .35$	
	Warren Foundry	$t = (.00008\, hd) + .0133\, d + .295$	
	New Castle.	$t = (.000\ldots)$ … 30-33, 23-24, 22-25, 23-32, 27-31; 4"-10" - 300 ft. head, 100, 150, 200, 250	

No.	Place	State			Year	Population
104.	Northampton,	Mass.	25	B.	1871.	13.200.
	Southington.	Conn.	10.	B.	1883-4	7.000.
105.	Palestine.	Tex.	8.	P.D.	1881-2	7.000.
108.	Marlboro.	Mass.		D.I.P.	1883.	10.500.
	Alameda.	Cal.	33.	R.	1879-80	8.000.
	Alliance.	O.	9.	D.I.P.	1878.	8.000.
	Birmingham,	Conn.	7.	G.	1859-60.	4.500.
	Brownsville,	Penn.	6.	R.	1883-4.	2.800.
	Catskill,	N.Y.	7.	R.	1884.	4.500.
	Cleveland,	O.	156.	R.	1855-6.	210.000.
110.	Jacksonville,	Fla.	8½	D.	1880.	10.000.
	Keeseville.	N.Y.	5	D.	1883.	25.000.
	New Brighton.	N.Y.	21.	P.	1881.	13.000.
	Newton,	Mass.	70.	D.I.P.	1876.	20.000.
	Olean,	N.Y.	9.	R.	1883.	7.000.
	Palestine.	Tex.	8.	P.D.	1881-2	7.000.
	Woodstock.	N.B.	6.	D.	1883-4.	3.000.
112.	St. Louis.	Mo.	245	R.	1829.	400.000.
115.	Columbus.	O.	62.	D.	1872.	65.000.
	Kalamazoo.	Mich.	20.	D.	1869.	15.000.
	Montreal.	Que.	139.	R.	1856.	150.000.
	St. Louis.	Mo.	245.	P.	1829.	400.000.
116.	Binghamton.	N.Y.	25.	D.	1868.	20.000.
117.	New Castle.	Pa.	14.	R.	1881.	8.000.
	Boston.	Mass.	394.	G.P.	1848.	400.700.

	Montreal.	Que.	438	P.	1856.	650.000.
	St. Louis.	Mo.	245	P.	1829	400.000.
115	Binghamton.	N.Y.	25	D.	1868.	20.000.
117	New Castle.	Pa.	16	D.	1881.	8.000.
120	Boston.	Mass.	394	G.P.	1848.	400.000.
	Meriden.	Conn.	29	G.	1874.	20.000.
	Newburg.	N.Y.	30	G.P.	1852 & ext.	20.000.
	Nanaimo.	B.	12	G.	1877.	8.000.
	Truro.	N.S.	5%	D.	1875	4.000
	St. Thomas.	Ont.	5	G.	1873.	11.000.
125	Cincinnati.	O.	222%	P.	1820.	300.000.
	Council Bluffs.	Ia.	23%	D.	1882-3.	24.000
	Wilmington.	N.C.	11%	P.	1827-78.	20.000
	Durham.	N.H.	2.	G.	1883.	15.000.
	Lowell.	Mass.	66.	P.R.	1872	70.000
	Pawtucket.	R.I.		P.	1878	40.000
	Rockford.	Ill.	31.	D.	1875	20.000
130.	Fort Wayne.	Ind.	21.	D.	1872-3.	34.000
	Thomastown.	Conn.	5%	G.	1880.	3.500
	Tiffin.	O.	7.	D.	1878.	7.000
	Mexican Laundry.	N.Y.				
	Yonkers.	N.Y.	31.	P.	1876	20.000
135	E. Orange.	N.J.	30%	D.	1882.	8.500.
140	Youngstown.	O.	17.	D.	1871-2	20.000
	Lawrence.	Mass.	50.	P.	1874-6	44.000
	Leaven worth.	Kan.	15	P.R.	1882	30.000.
	Leadville.	Col.	45	P.	1879	20.000.
	Philadelphia.	Pa.	801		1798 & subs.	2427.000.
	Port Huron.	Mich.	25.	D.	1873.	16.000.
150	Sarnia.	Ont.	10.	D.	1876	5.000.
	Sherburne.	N.Y.	11	G.	1883.	1.000.
	Sorel.	P.Q.	14	D.	1872.	7.000.
	Three Rivers.	P.Q.	14	G.D.	1876	10.000
	Wellsville.	O.	7	D.I.P.	1881.	5.000.
	Woodstock.	Ont.	3	D.	1880	7.000
155	Hollister.	N.S.	56.	G.	1848.	40.000.
	Hamilton.	Ont.	14%	D.	1882-3	14.000
170	Lowell.	Mass.	77	P.	1872.	70.000.
	Adams.	Mass.	10+	G.	1883.	5.000.
175	Edinburg.	Mass.	8	G.	1872	16.500
	Santa Fe.	N.M.	8.	G.	1882	8.000.
180	Muscatine.	Ia.	5%	D.I.P.	1876.	12.000.
	Peoria.	Ill.	43	D.	1868.	42.000.
185	Springfield.	Mass.	24	G.	1864. 74.	39.000.
	Albany.	Ga.	21	D.	1875.	45.000.
	Carmody.	N.Y.	7	G.P.	1871.	7.000
	Kansas City.	Mo.	52	P.	1870	90.000
	Milford.	Mass.	11	D.	1881-3.	10.000.
200	Newton.	Kan.	5%	D.	1884.	6.000.
	Northampton.	Mass.	25	G.	1884.	6.000.
	Ottawa.	Ont.	145	G.	1871.	13.200
	San Francisco.	Cal.	200	G.	1876.	27.000
	Taunton.	Mass.	47	D.	1860-85.	270.000.
210	Baltimore.	Md.	304%	D.	1878.	21.200.
					1862, 81.	400.000.
220	St. Catherine.	Ont.	17¾	G.	1877.	10.350.
	Worcester.	Mass.	46	G.	1864-87.	70.000.
240	Burlington.	N.J.	8	P.D.	1878.	7.500.
250	Kingston.	Ont.		G.	1843.	14.000
270	Quebec	P.Q.	36	G.	1853	60.000
		Ill.				
300	Lake.	Mass.	66	G.	1874.	30.000
	Westfield.	Mass.		G.	1874.	9.000
320	Milwaukee.	Wis.	111	P.	1871-73.	150.000.
430	Quebec.	PQ	36	G.	1853	60.000.

F. L. Pumped. Mil.

140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10

14"

References:

D. Direct pumping into mains.
G. Gravity to Reservoir.
G.P. Gravity & Pump.
P.D. Pumped to Rest & direct to mains.
D.I.P. Direct, indirect pumping.

Sizes of Pipes.

4" 6" 8" 10" 12"

Pressure.	Place.	State.	Miles.	System.	Date of Construction.	Population.
20.	Denver,	Col.	43.	D.	1872.	75.000.
	New Orleans,	La.	70½	D.I.P.	1833.	235.000.
21.	New Bedford,	Mass.	39¼	P.	1865.	33.000.
	Oakland,	Cal.	123.	P.	1866.	40.000.
22.	Oakland,	Cal.	123.	P.	1866.	40.000.
	Warren Foundry,	N.J.				
30.	Bridgeton,	N.J.	14⅜	P.	1877.	11.000.
35.	Bridgeton,	N.J.	14⅜	P.	1877.	11.000.
37.	Worcester,	Mass.	46.	G.	1864-67.	70.000.
	Bridgeton,	N.J.	14⅜	P.	1877.	11.000.
40.	Newark,	N.J.	146½	P.	1867-9.	152.000.
	Trenton,	N.J.	40.	P.	1803. 1853.	30.000.
43.	Providence,	R.I.	184.	D.I.P.	1772. 1870.	120.000.
43½	Oakland,	Cal.	123.	P.	1866.	40.000.
46.	York,	Pa.	10½	P.	1816.	16.000.
48.	Detroit,	Mich.	177.	P.	1827.	152.500.
50.	Bridgeton,	N.J.	14⅜	P.	1877.	11.000.
	Gorham,	N.H.	2.	G.	1873.	1.500.
54.	Chicago,	Ill.	584.	P.	1853.	650.000.
55.	Newark,	N.J.	146½	P.	1867-9.	152.000.
60.	Evansville,	Ind.	32½	D.	1870.	45.000.
	Wilmington,	Del.	65.	P.	1827. 1878.	50.000.
65.	Oakland,	Cal.	123.	P.	1866.	40.000.
66.	Holyoke,	Mass.	34.	G.	1873.	30.000.
	New Bedford,	Mass.	39¼	P.	1865.	33.000.
70.	Canandaigua,	N.Y.	9.	P.	1884.	6.000.
	Memphis,	Tenn.	42.	D.	1872.	60.000.
71.	St. John,	N.B.	46.	G.	1836. 1849.	38.600.
	Syracuse,	N.Y.		G.P.	1829.	64.000.
75.	Danville,	Ill.	14.	P.	1883.	15.000.
76.	Worcester.	Mass.	46.	G.	1864-67.	70.000.
77½	Providence,	R.I.	184.	D.I.P.	1772. 1872.	120.000.
	St. Louis,	Mo.	245.	P.	1833. 67-73.	400.000.
	Manchester.	N.H.	15.	P.	1872.	36.000.
	New York,	N.Y.	550.	G.	1842 to date.	1.400.000.
80.	Portland,	Me.	33⅜	G.	1869.	35.000.
	Richmond.	Va.	64.	P.	1831.	40.000.
	E. Saginau,	Mich.	28.	D.	1873.	30.000.
	Waltham,	Mass.	5⅞	D.I.P.	1872-3.	14455.
83.	Boston,	Mass.	394.	G.P.	1848.	400.000.
	Phoenixville,	Pa.	11.	P.	1872-3.	7.500.
	Hamilton,	O.	26¼	P.	1883-5	16.000.
	London,	Ont.	45.	P.	1879.	20.000.
85.	Newark,	N.J.	146½	P.	1867-9.	152.000.
86.	Yonkers,	N.Y.	31.	P.	1876.	20.000.
87.	Oakland.	Cal.	123.	P.	1866.	40.000.
	Burlington	N.J.	8.	P.D.	1878.	7.500.
90.	Hannibal,	Mo.	13⅞	P.	1879.	15.000.
	Jamestown.	N.Y.	14.	D.	1882.	12.000.
98.	Holyoke,	Mass.	34.	G.	1873.	30.000.
	Salt Lake City.	U.T.	14.	G.	1873.	25.000.
	Cedar Rapids,	Ia.	13.	D.	1875.	2.000.
	Gorham.	N.H.	2.	G.	1883.	1.500.
	Minneapolis,	Minn.	45.	D.	1867.	100.000.
	Troy.	N.Y.	45.	G.D.	1830-85.	60.000.
	Washington.	D.C.	180.	G.	1859.	180.000.

Weight of pipe per foot as deduced from different formulae.

J.T. Fanning. $t = \left(\frac{\text{pressure in lbs.}}{1.5}\right) d + .333 (1 + d)$

M. Dupuit. $t = (.0016\, np)\, d + .013\, d + .32$

J.F. D'Aubuisson. $t = (.015\, d)\, p + .295$

Julius Weisbach. $t = (.00238\, np) + .34$

Dionysius Lardner. $t = (.007\, pr) + .38$

Thomas Box. $t = \left[\left(\frac{12}{10} + .18\right) p\right] + \frac{.36}{2800}$

G.L. Molesworth. $t = (.00006\, pd) + \begin{cases} .37 \text{ for } 4'' \text{ to } 12'' \\ .5 - 12'' - 30'' \\ .62 - 30'' - 50'' \end{cases}$

709. W.J.M. Rankine. $t = \left(\frac{p}{418}\right)$

John Neville. $t = [.0016 (pn + a)\, d] + .32$

Thos. Hawksley. $t = .181$

Baldwin Latham. $t = \frac{\text{head}}{2283} + .25$

James B. Francis. $t = (.000053\, hd) + .053\, d + .312$

Thos. J. Whitman. $t = (.0045\, nd) + .4 - .0011\, d$

M.C. Meigs. $t = (.0256\, 4.16\, d) + .25$

J.H. Speed. $t = (.00002\, hd) + .0216\, d + .86$

J.F. Ward. $t = (.00026\, hd) + .30$

Jos. P. Davis. $t = (.00475\, nd) + .35$

$t = (.0001\, hd) + .35$

Warren Foundry. $t = (.00006\, hd) + .04\, d + .334\, d + .295$

New Castle. $t = (.00005\, hd) \begin{cases} 30 - 35 \\ 28 - 30 \\ 27 - 28 \\ 26 - 27 \end{cases}$ $4' - 16' - 8$ ft. head. $100 \cdot \cdot$ $200 \cdot \cdot$ $250 \cdot \cdot$

t = thickness of pipe in metres.
d = diameter " " "
h = head of water in feet.
w = 62.5 lbs.
n = atmospheres at 33 ft. each.
p = pressure in lbs. per sq. inch.
s = 18000 lbs.

104.	Northampton,	Mass.	25.	G.	1871.	13.000.
108.	Marlboro,	Mass.		D.I.P.	1883.	10.500.
	Alliance,	O.	9.	D.I.P.	1878.	8.000.
110.	Cleveland,	O.	196.	P.	1855-6.	210.000.
	Jacksonville.	Fla.	68.	D.	1880.	10.000.
	Newton,	Mass.	70.	D.I.P.	1876.	20.000.
112.	St. Louis.	Mo.	245.	P.	1829.	400.000.
	Columbus.	O.	62.	D.	1872.	65.000.
115.	Kalamazoo,	Mich.	20.	D.	1869.	15.000.
	Montreal,	Que.	130.	P.	1856.	150.000.
	Worcester.	Mass.	46.	G.	1864-67.	70.000.
116.	Birmingham	N.Y.	25.	D.	1868.	20.000.
	Boston,	Mass.	394.	G.P.	1848.	400.000.
	Meriden.	Conn.	29.	G.	1874.	20.000.
120.	Newburg.	N.Y.	30.	G.P.	1852 to date.	20.000.
	Norwalk	O.	12.	G.	1871.	8.000.
125.	Cincinnati,	O.	222½	P.	1820.	300.000.
	Council Bluff,	Ia.	23¼	D.	1882-3.	28.200.
	Lowell.	Mass.	77.	P.	1872.	70.000.
	Pawtucket.	R.I.	85.	P.	1878.	40.000.
130.	Terre Haute.	Ind.	21.	D.	1872-3.	34.000.
	Tiffin.	O.	7.	D.	1878.	7.000.
	Warren Foundry.	N.J.				
	Yonkers.	N.Y.	31.	P.	1876.	20.000.
140.	Youngstown.	O.	17.	D.	1871-2.	20.000.
	Lawrence.	Mass.	50.	P.	1874-6.	44.000.
	Leavenworth.	Kan.	18.	P.	1882.	30.000.
	London.	Ont.	45.	P.	1879.	20.000.
	Meriden.	Conn.	29.	G.	1874.	20.000.
150.	Philadelphia.	Pa.	801.	P.	1788 to date.	847.000.
	Port Huron.	Mich.	25.	D.	1873.	10.000.
	Spechunk	N.Y.		G.	1883.	1.000.
	Halifax.	N.S.	56.	G.	1848.	40.000.
155.	Madison,	Wis.	14½	D.	1882-3.	14.000.
170.	Lowell.	Mass.	77.	P.	1872.	70.000.
175	Fitchburg.	Mass.	9.	G.	1872.	16.580.
180	Muscatine.	Ia.	5½	D.I.P.	1876.	12.000.
	Peoria.	Ill.	42.	D.	1868.	42.000.
185	Springfield.	Mass.	24.	G.	1864-74.	39.000.
	Kansas City.	Mo.	52.	P.	1875.	90.000.
	Milford.	Mass.	11.	D.	1881-3.	10.000.
					1876.	27.000.
200	Ottawa,	Ont.	45.	D.	1860-85.	270.000.
	San Francisco.	Cal.	200.	G.		

Weight of pipe in lbs. per foot.

140 150 160 170 180 190 200 210 220 230 240 250

*2.

Statistics of the weight

— in practi

and

—— theoretical weight dedu

Cl

Weight of pipe in lbs. per foo

110 120 130 140 150 160 170 180 190 200 210

Statu

theore

per foot.

220 230 240 250 260 270 280 290 300 310

*2.

Statistics of the weights of Cast Iron Pipe

— in practical use —

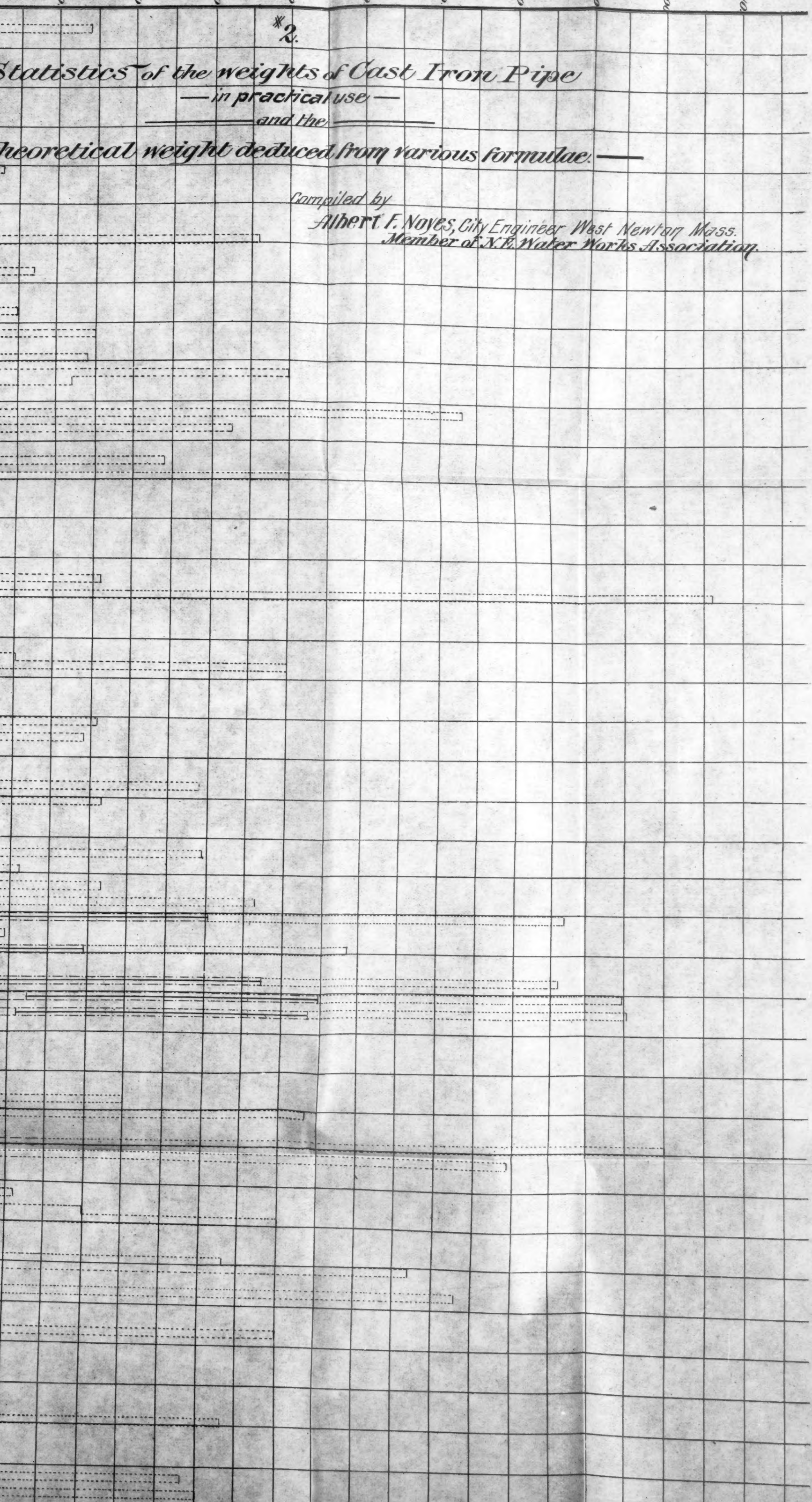
and the

Theoretical weight deduced from various formulae. —

Compiled by

Albert F. Noyes, City Engineer West Newton Mass.

Member of N.E. Water Works Association.

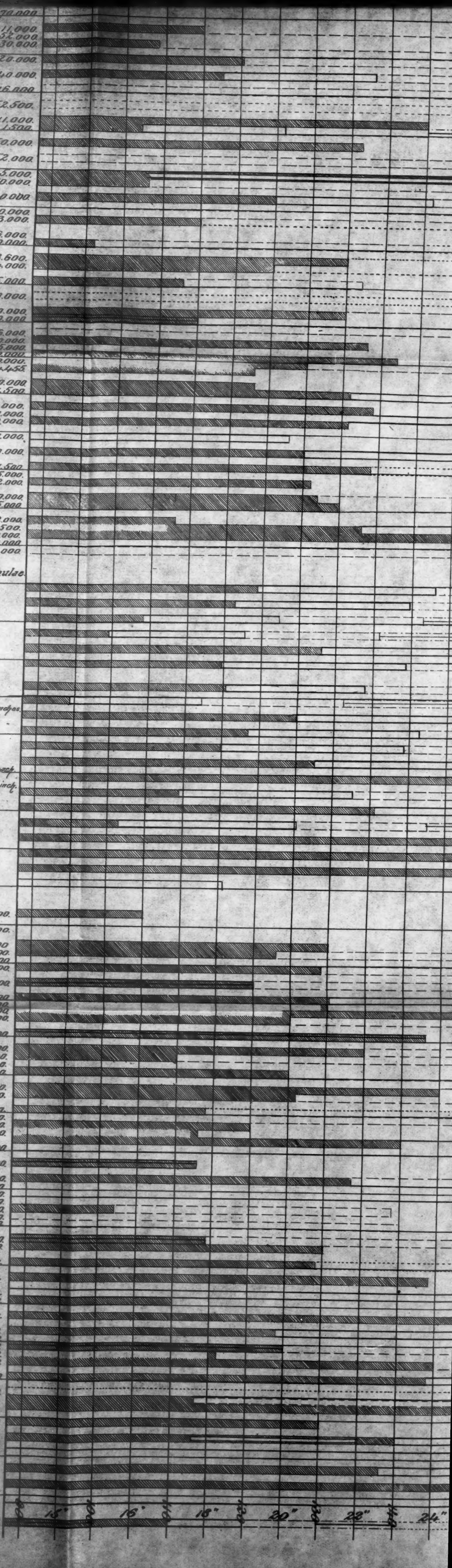


37.	Worcester,	Mass.	46.	G.	1864-67.	70.000
40.	Bridgeton,	N.J.	14⅝	P.	1877.	11.000.
	Newark,	N.J.	146½	P.	1867-9.	152.000.
	Trenton,	N.J.	40.	P.	1803. 1853.	30.000.
43.	Providence,	R.I.	184.	D.I.P.	1772. 1870.	120.000.
43½	Oakland,	Cal.	123.	P.	1866.	40.000.
46.	York,	Pa.	10½	P.	1816.	16.000.
48.	Detroit,	Mich.	177.	P.	1827.	152.500.
50.	Bridgeton,	N.J.	14⅝	P.	1877.	11.000.
	Gorham,	N.H.	2.	G.	1873.	1.500.
54.	Chicago,	Ill.	584.	P.	1853.	650.000.
55.	Newark,	N.J.	146½	P.	1867-9.	152.000.
60.	Evansville,	Ind.	32½	D.	1870.	45.000.
	Wilmington,	Del.	65.	P.	1827. 1878.	50.000.
65.	Oakland,	Cal.	123.	P.	1866.	40.000.
66.	Holyoke,	Mass.	34.	G.	1873.	30.000.
	New Bedford,	Mass.	39¼	P.	1865.	33.000.
70.	Canandaigua,	N.Y.	9.	P.	1884.	6.000.
	Memphis,	Tenn.	42.	D.	1872.	60.000.
71.	St. John,	N.B.	46.	G.	1836. 1849.	38.600.
	Syracuse,	N.Y.		G.P.	1829.	64.000.
75.	Danville,	Ill.	14.	P.	1883.	15.000.
76.	Worcester.	Mass.	46.	G.	1864-67.	70.000.
77½	Providence,	R.I.	184.	D.I.P.	1772. 1872.	120.000.
	St. Louis,	Mo.	245.	P.	1833. 67-73.	400.000.
	Manchester,	N.H.	15.	P.	1872.	36.000.
	New York,	N.Y.	350.	G.	1842 to date.	1.400.000.
80.	Portland,	Me.	33⅜	G.	1869.	35.000.
	Richmond,	Va.	24.	G.	1831.	80.000.
	E. Saginaw,	Mich.	28.	D.	1873.	30.000.
	Waltham,	Mass.	5⅞	D.I.P.	1872-3.	14455.
83.	Boston,	Mass.	394.	G.P.	1848.	400.000.
	Phoenixville,	Pa.	11.	P.	1872-3.	7.500.
	Hamilton,	O.	26¼	P.	1883-5.	16.000.
	London,	Ont.	45.	P.	1879.	20.000.
85.	Newark,	N.J.	146½	P.	1867-9.	152.000.
86.	Yonkers,	N.Y.	31.	P.	1876.	20.000.
87.	Oakland,	Cal.	123.	P.	1866.	40.000.
	Burlington,	N.J.	8.	P.D.	1878.	7.500.
90.	Hannibal,	Mo.	13⅞	P.	1879.	15.000.
	Jamestown,	N.Y.	14.	D.	1882.	12.000.
98.	Holyoke,	Mass.	34.	G.	1873.	30.000.
	Salt Lake City,	U.T.	14.	G.	1873.	25.000.
	Cedar Rapids,	Ia.	13.	D.	1875.	2.000.
	Gorham,	N.H.	2.	G.	1883.	1.500.
	Minneapolis,	Minn.	45.	D.	1867.	100.000.
	Troy,	N.Y.	45.	G.D.	1830-85.	60.000.
	Washington,	D.C.	180.	G.	1859.	180.000.

Weight of pipe per foot as deduced from different formulae.

J.T. Fanning.	$t=\left(\frac{p\,r}{4.2}\right)+.333\left(\frac{p}{w}\right)$	
M. Dupuit.	$t=(.0016\,pd)+.013d+.32$	
J.F. D'Aubuisson	$t=(.015\,pd)+.325$	
Julius Weisbach.	$t=(.00238\,pd)+.34$	
Thaysius Lardner	$t=(.009\,pr)+.38$	
Thomas Box.	$t=\left[\frac{pr}{10}+.15\right]+\frac{pr}{2500}$	
S.L. Molesworth.	$t=(.00006\,pd)+\left\{\begin{matrix}.37 \text{ for } 4\text{" to } 12\text{"}\\ .5 \text{ " } 12\text{" - } 30\text{"}\\ .63 \text{ " } 30\text{" - } 54\text{"}\end{matrix}\right.$	
Wm. J.M. Rankine.	$t=\left(\frac{p\,r}{s}\right)$	r = radius.
John Neville.	$t=[.0016(p+w)d]+.32$	t = thickness of pipe in inches.
Thos. Hawksley	$t=18\sqrt{d}$.	d = diameter - - - -
Baldwin Latham.	$t=\frac{p\,d}{29.85}+.25$	p = head of water in feet.
James B. Francis.	$t=(.00058\,pd)+.0152\,d+.312$	w = 62.5 lbs.
Thos. J. Whitman.	$t=(.0015\,pd)+.4-.0011\,d.$	n = atmospheres at 33 ft. each
M.C. Meigs.	$t=(.0264\,p\,d)+.25$	p = pressure in lbs. per sq. inch.
J.H. Shedd	$t=(.00028\,p\,d)+.016\,d+.16$	s = 18000 lbs.
J.F. Ward.	$t=(.0002\,pd)+.30$	
Jos. P. Davis.	$t=(.0004\,pd)+.25$	
	$t=(.00046\,pd)+.35$	
Warren Foundry.	$t=(.00046\,pd)+.0133\,d+.295$	
New Castle.	$t=(.00046\,pd)+\left\{\begin{matrix}30-35 & 4\text{"-6"} & 50 \text{ ft. head.}\\ 27-34 & & 100 \text{ " "}\\ 26-33 & & 200 \text{ " "}\\ 25-32 & & 250 \text{ " "}\\ 26-34 & & \end{matrix}\right.$	

104.	Northampton,	Mass.	25.	G.	1871.	13.000.
108.	Marlboro,	Mass.		D.I.P.	1883.	10.500.
	Alliance,	O.	9.	D.I.P.	1878.	8.000
110.	Cleveland,	O.	196.	P.	1855-6.	210.000.
	Jacksonville,	Fla.	8.	D.	1880.	10.000.
	Newton,	Mass.	70.	D.I.P.	1876.	20.000.
112.	St. Louis,	Mo.	245.	P.	1829.	400.000.
	Columbus,	O.	62.	D.	1872.	65.000.
115.	Kalamazoo,	Mich.	20.	D.	1869.	15.000.
	Montreal,	Que.	100.	P.	1856.	150.000.
	Worcester.	Mass.	46.	G.	1864-67.	70.000.
116.	Birmingham	N.Y.	25.	D.	1868.	20.000.
	Boston,	Mass.	394.	G.P.	1848.	400.000.
120.	Meriden,	Conn.	29.	G.	1874.	20.000.
	Newburg,	N.Y.	30.	G.P.	1852 to date.	20.000.
	Norwalk,	O.	12.	G.	1871.	8.000.
125.	Cincinnati,	O.	222½	P.	1820.	300.000.
	Council Bluff,	Ia.	23¾	D.	1882-3.	28.200.
	Lowell,	Mass.	77.	P.	1872.	70.000.
	Pawtucket,	R.I.	85.	P.	1878.	40.000.
130.	Terre Haute,	Ind.	21.	D.	1872-3.	34.000.
	Tiffin,	O.	7.	D.	1878.	7.000.
	Warren Foundry,	N.J.				
	Yonkers,	N.Y.	31.	P.	1876.	20.000.
140.	Youngstown.	O.	17.	D.	1871-2.	20.000.
	Lawrence,	Mass.	50.	P.	1874-6.	44.000.
	Leavenworth	Kan.	18.	P.	1882.	30.000.
	London,	Ont.	45.	P.	1879.	20.000.
150.	Meriden,	Conn.	29.	G.	1874.	20.000.
	Philadelphia,	Pa.	801.	P.	1798 to date.	847.000.
	Port Huron,	Mich.	25.	D.	1873.	10.000.
	Spectacle	N.Y.		G.	1883.	1.000.
155.	Halifax,	N.S.	56.	G.	1848.	40.000.
	Madison,	Wis.	14½	D.	1882-3.	14.000.
170.	Lowell.	Mass.	77.	P.	1872.	70.000.
175	Fitchburg.	Mass.	9.	G.	1872.	16.580.
180	Muscatine.	Ia.	5½	D.I.P.	1878.	12.000.
	Peoria.	Ill.	42.	D.	1868.	42.000.
185	Springfield.	Mass.	24.	G.	1864-74.	39.000.
	Kansas City.	Mo.	52.	P.	1875.	90.000.
	Milford.	Mass.	11.	D.	1881-3.	10.000.
200	Ottawa,	Ont.	45.	D.	1876.	27.000.
	San Francisco,	Cal.	200.	G.	1866-85.	270.000.
	Taunton,	Mass.	47.	D.	1876.	21.200.
210	Baltimore,	Md.	3044	D.	1862-81.	400.000.
	Boston,	Mass.	394.	G.P.	1848.	400.000.
220	St. Catherine,	Ont.	17¾	G.	1871.	10.250.
	Worcester.	Mass.	46.	G.	1864-67.	70.000.
240	Burlington,	N.J.	8.	P.D.	1878.	7.500.
250	Kingston,	Ont.		G.	1849.	14.000.
299	Quebec.	P.Q.	36.	G.	1853.	60.000.
300	Lake,	Ill.	66.	P.	1874.	30.000.
320	Milwaukee.	Wis.	111.	P.	1871-73.	150.000.
430	Quebec.	P.Q.	36.	G.	1853.	60.000.



Sizes of Pipes.

——— and

—— theoretical weight dedu

C

24"

150

160

170

180

190

200

210

220

230

240

250

theor

18" 20" 22" 24"

150 160 170 180 190 200 210 220

and the

coretical weight deduced from various formulae.

Compiled by
Albert F. Noyes, City Engineer West Newton Mass.
Member of N.E. Water Works Association

H.D. Woods, Del.

220 230 240 250 260 270 280 290 300 310

Stat

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Pressure.	Place.	State.	Miles.	System.	Date of construction.	Population.
20.	New Orleans,	La.	70½	D.I.P.	1833.	235,000.
21.	New Bedford,	Mass.	39¼	P.	1865.	33,000.
22.	Warren Foundry	N.J.				
25.8	Providence,	R.I.	184.	D.I.P.	1772. 1870.	120,000.
30.	Newark.	N.J.	146½	P.	1867-9.	152,000.
37.	Worcester;	Mass.	46.	G.	1864-7.	70,000.
40.	Trenton,	N.J.	40.	P.	1803. 1853.	30,000.
43.	Providence,	R.I.	184.	D.I.P.	1772. 1870.	120,000.
48.	Detroit,	Mich.	177.	P.	1827.	152,500.
50.	Gorham.	N.H.	2.	G.	1873.	1500.
54.	Chicago.	Ill.	584.	P.	1853.	650,000.
55.	Newark,	N.J.	146½	P.	1867-9.	152,000.
60.	Providence,	R.I.	184.	D.I.P.	1772, 1870	120,000.
66.	New Bedford,	Mass.	39¼	P.	1865.	33,000.
71.	Syracuse.	N.Y.	-	G.P.	1824.	64,000.
77½	Providence,	R.I.	184.	D.I.P.	1772. 1870.	120,000.
	St. Louis,	Mo.	245.	P.	1833. 67, 73.	400,000.
80.	New York.	N.Y.	550.	G.	1842 to date.	1,400,000.
	Richmond,	Va.	61.	P.	1831.	80,000.
87.	Oakland,	Cal.	123.	P.	1866.	40,000.
	Gorham,	N.H.	2.	G.	1873.	1500.
	Troy,	N.Y.	45.	G.D.	1830-83.	60,000.
	Washington,	D.C.	180.	G.	1859.	180,000.

Weight of pipe per foot as deduced from different formulas.

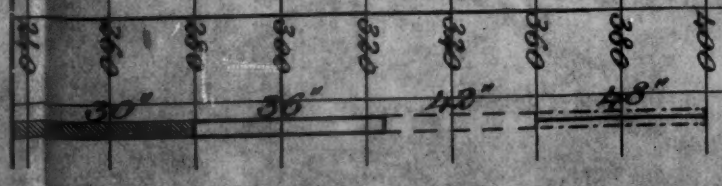
J. T. Fanning.	$t=\frac{(p+100)d}{4.5}+.393(=\frac{w}{.262})$
M. Dupuit,	$t=(.0026pd)+.013d+.32$
J. F. D'Aubusson.	$t=(.015d)+.295$
Julius Weisbach,	$t=(.0238md)+.34$
Dionysius Lardner	$t=(.029pd)+.38$
Thomas Box.	$t=(\frac{pd}{70}+.15)+\frac{hd}{15000}$
G. L. Molesworth.	$t=(.00054hd)+\begin{cases}.37 \text{ for } 4''\text{ to }12''\\ .52 \text{ " } 12''\text{ - }30''\\ .62 \text{ " } 30''\text{ - }50''\end{cases}$
Wm. J. M. Rankine,	$t=\frac{1.6d}{23}$
John Neville,	$t=[.0016(n+10)d]+.32$
Thos. Hawksley,	$t=.181d.$
Baldwin Latham.	$t=\frac{wh^2d}{2000S}+.25$
James B. Francis.	$t=(.00054hd)+.0152d+.312$
Thos. J. Whitman.	$t=(.0045md)+.4-.0011d.$
M. C. Meigs.	$t=(.0260416d)+.25$
J. H. Shedd,	$t=(.00008hd)+.01d+.36$
J. F. Ward.	$t=(.0002hd)+.30$
Jas. P. Davis.	$t=(.00075pd)+.35$
	$t=(.00015hd)+.35$
Warren Foundry.	$t=(.00006hd)+.0133d+.295$
New Castle,	$t=(.0001hd)+\begin{cases}30-35 & 4''-16''\\ 29-34 & \\ 28-33 & \\ 27-32 & \\ 26-31 & \end{cases}\begin{matrix}\text{So Ft. head}\\ 100 \text{ " "}\\ 150 \text{ " "}\\ 200 \text{ " "}\\ 250 \text{ " "}\end{matrix}$

Pressure.	Place.	State.	Miles.	System.	Date of construction.	Population.
110.	Cleveland.	O.	96.	P.	1855-6.	210,000.
112.	St. Louis,	Mo.	245.	P.	1829.	400,000.
115.	Montreal,	Que.	139.	P.	1856.	150,000.
120.	Boston.	Mass.	394.	G.P.	1848.	400,000.
	Norwalk	O.	12.	G.	1871.	8,000.
125.	Cincinnati,	O.	222½	P.	1820.	300,000.
	Council Bluffs.	Ia.	23½	D.	1852-3.	28,200.
130.	Lowell,	Mass.	77.	P.	1872	70,000.
	Warren Foundry.	N.J.				
150.	Lawrence,	Mass.	50.	P.	1874-76.	44,000.
	Philadelphia,	Pa.	801.	P.	1798 to date.	847,000.
170.	Lowell,	Mass.	77.	P.	1872.	70,000.
200.	Kansas City.	Mo.	62.	P.	1875.	30,000.
210.	Baltimore,	Md.	304½	D.	1862-81.	400,000.
220.	Boston.	Mass.	394.	G.P.	1848	400,000.
	Worcester.	Mass.	46.	G.	1864-67.	70,000.
279.	Quebec,	P.Q.	36.	G.	1853.	60,000.
300.	Lake,	Ill.	66.	P.	1874.	30,000.
320.	Milwaukee.	Wis.	111	P.	1871-73.	150,000.

References;

D. Direct pumping into mains.
G. Gravity.
P. Pump to Reservoir.
G.P. Gravity & Pump.
P.D. Pump to Res.r & direct to mains.
D.I.P. Direct, indirect pumping.

Sizes of Pipe.



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Statistics of the weights of Cast Iron Pipe

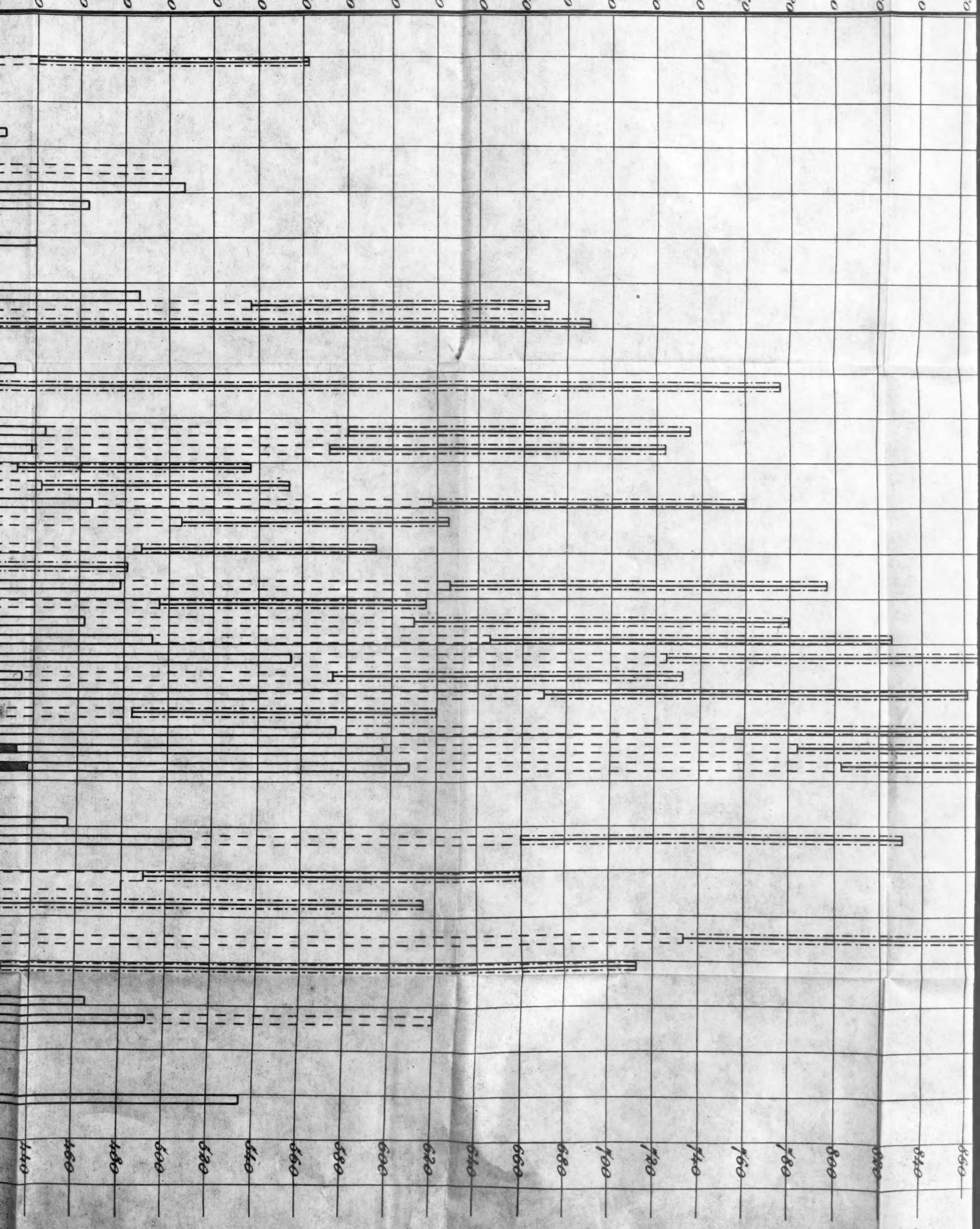
— in practical use —

— and the —

Theoretical weight deduced from various formulae. —

Compiled by —
Albert F. Noyes, City Engineer, West Newton Mass.
Member of N.E. Water Works Association.

Weight of Pipe in lbs. per foot.



1/3

Statistics of the weights of Cast Iron Pipe

— in practical use —

— and the —

— theoretical weight deduced from various formul

Compiled by —
Albert F. Noyes, City Engi
Member of N.E. W

Weight of Pipe in lbs. per foot.

280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700

36" 42" 48"

Pipe

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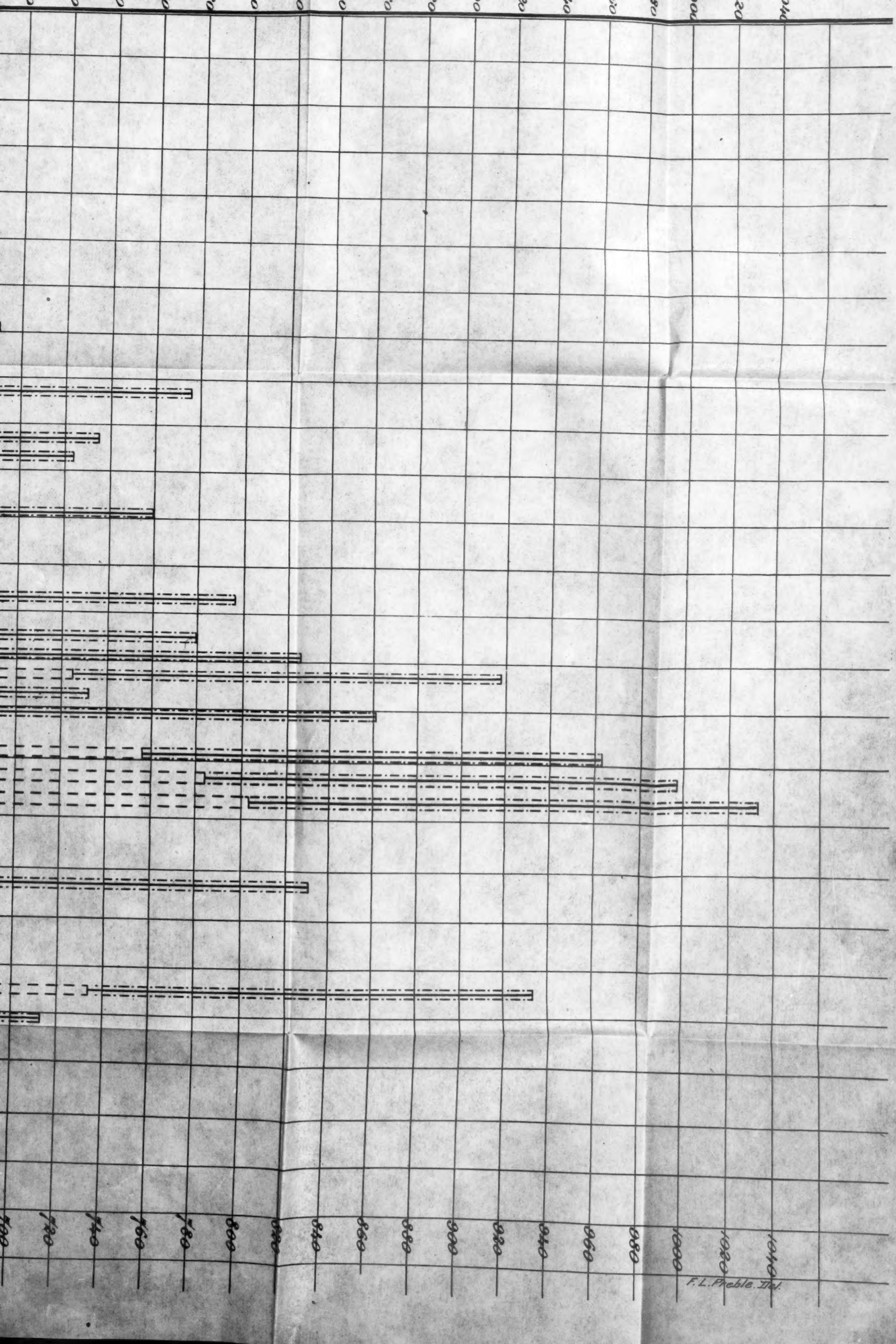
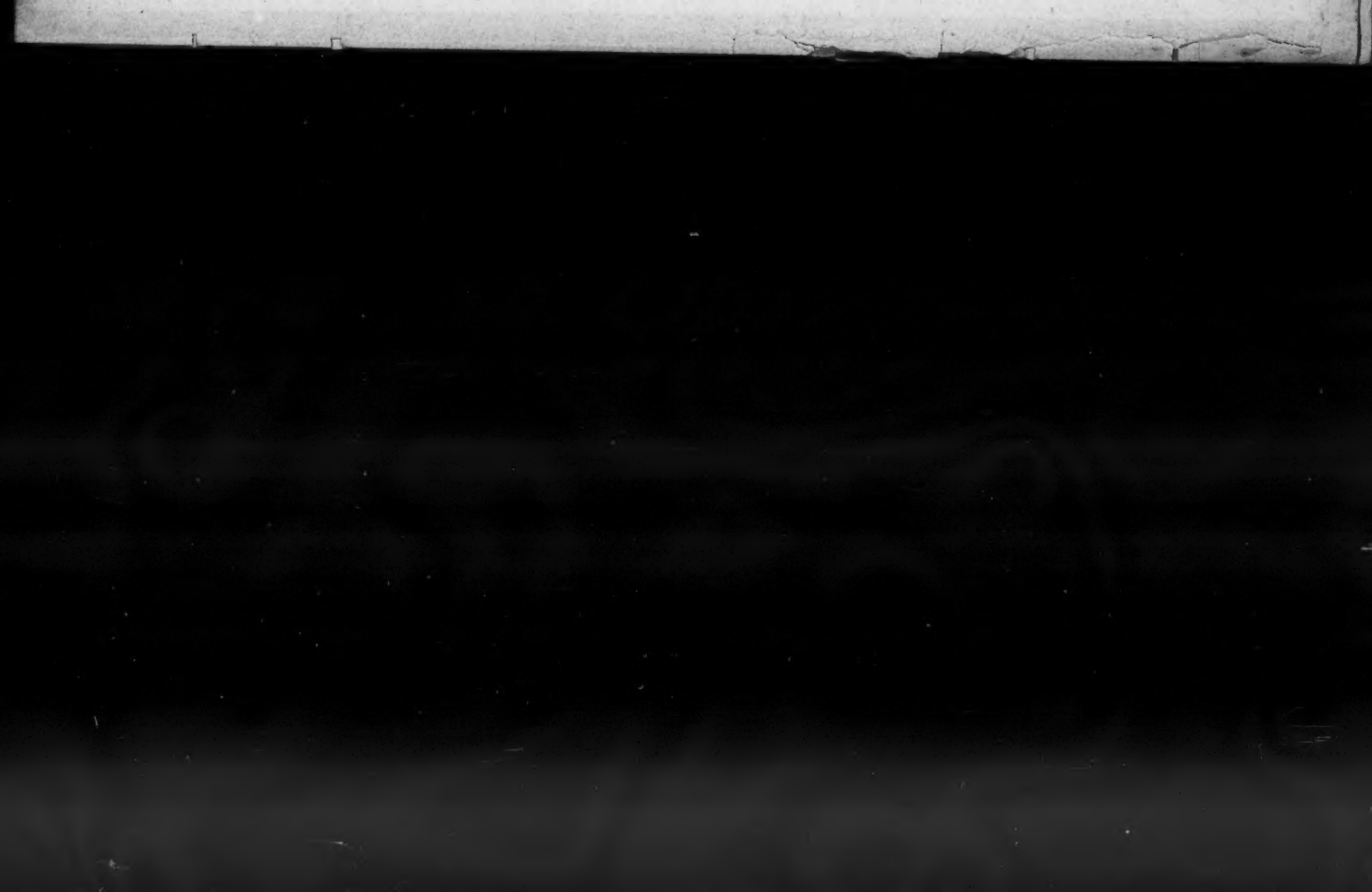
ity Engineer, West Newton Mass.
f N.E. Water Works Association.





trace a reason for this, for the apparent inconsistency occurs both in works supplied by gravity, pumping to reservoir, direct or indirect pumping.

Neither can I trace the cause to the different manufactures, for it occurs in the different works, supplied from the same, as well as those supplied by a number of makers; from but few of the works are we able to determine the quality of the iron used: it is iron pipe of such a manufacture; probably not varying, in tensile strength, far from fifteen thousand to eighteen thousand lbs. per square inch.

For the sake of comparison I have tabulated the weights of the various sizes of iron pipe used under similar pressures within certain limits, using a maximum pressure of seventy-five pounds per square inch, as a minimum pressure for comparison. In estimating the maximum pressure at any works I have added the highest recorded pressures, from water hammer or other cause, as being the highest pressure the pipes are subjected to. By reference to said tables it will be observed that two works having a maximum pressure between one hundred and twenty-five and one hundred and fifty pounds per square inch, are using four-inch pipe weighing between sixteen and seventeen pounds per foot, while one is using pipe weighing thirty-one pounds per foot in length, two between twenty-five and twenty-six, one between twenty-four and twenty-five, one between twenty-three and twenty-four, and five between twenty-two and twenty-three pounds pipe, with a maximum pressure of seventy-five or less pounds per square inch. One works, with a pressure of between two hundred and three hundred pounds, is using four-inch pipe weighing seventeen and eighteen pounds per foot. As the sizes increase, this inconsistency in practice is more apparent. In comparing the weights of the various sizes of pipe in use when there is a maximum recorded pressure of less than

seventy-five pounds, with those where the maximum recorded pressure is between two and three hundred pounds per square inch, I find the following variation in weights:—

Size of Pipe.	Maximum pressure less than 75 lbs.	Maximum pressure between 200 & 300 lbs.	Variation in weights as deduced from various formulas with a maximum pressure of 100 lbs.
4 inch.	16— 31 lbs.		12½— 23½ lbs.
6 "	25— 47 "	28— 48 lbs.	22 — 38 "
8 "	35— 68 "	42— 63 "	34 — 59½ "
10 "	46— 80 "	56— 79 "	47 — 74½ "
12 "	64—117 "	75—109 "	61½— 97 "
14 "	79—138 "	93—136 "	77½— 123 "
16 "	87—175 "	110—168 "	94½— 150½ "
18 "	114—161 "	150—173 "	112 — 183 "
20 "	131—210 "	150—243 "	136 — 212½ "
22 "	162—193 "	208—220 "	150½— 254½ "
24 "	177—273 "	238—273 "	172 — 295½ "
30 "	252—372 "	345—410 "	239 — 438 "
36 "	340—506 "	465—492 "	314 — 608 "
42 "	439—636 "		396 — 803 "
48 "	561—688 "	714 "	481 —1033 "

An examination of the accompanying diagrams will show in works where the maximum pressure is between those taken as a basis for comparison an even wider range of practice than that given above, and the weights of pipe as deduced from the various formulas vary in a far greater proportion than that found in practice.

Referring to the various literature upon the subject one is still more puzzled, and by the time he has read his way through the mass he is liable to be more mystified than ever. Fanning, in his treatise on Water Supply, page 466, gives seventeen formulas for computing the thickness of cast-iron

pipe. All formulated by men standing high in reputation as engineers and thinking men; yet with an assumed static pressure of seventy-five pounds per square inch, and assumed tenacity of metal of eighteen thousand pounds per square inch, the extreme variation in thickness of metal for a four-inch pipe is:

	Highest, .4900 inch,	Thomas J. Whitman.
	Lowest, .2887 "	Wm. J. M. Rankin.
12-in.	Highest, .6699 "	Thomas J. Whitman.
	Lowest, .4897 "	Julius J. Weisbach.
24-in.	Highest, 1.1304 "	J. F. Ward.
	Lowest, .7071 "	Wm. J. M. Rankin.
48.in.	Highest, 1.9608 "	J. F. Ward.
	Lowest, .9389 "	Julius Wiesbach.

But few of the correspondents record failure, and these are generally from settlement of ground, imperfect work in casting, or when under test pressure.

The result of these comparisons can but show that either too great risk is assumed in places using the lighter weight pipe, or that those using the heavier weight pipe are paying an extraordinary rate of insurance against breakage, on account of unnecessary weight of metal in the pipe. The importance of the more careful consideration of the question as to what is the safe and economical weight of cast-iron pipe to be used under the varying conditions of the various works, can not be over-estimated. It means the saving of thousands of dollars in the cost of construction, or the avoidance of vexatious and expensive bursts of the mains after being laid. Each of these extremes should be avoided, and, if possible, a uniformity of quality of material, method of manufacture and inspection insisted upon. After a careful review of the conclusions of the various authorities who have written upon this subject, and the lack of positive information

as to the maximum pressure pipes may have to stand, I cannot see that any cast-iron rule can be laid down governing all places and all foundries. There are local conditions, generally different works, which must be left to the judgment of the advising office.

Most specifications call for the pipe being made from a tough, soft iron, which can be easily cut, having a tensile strength of sixteen to eighteen thousand pounds per square inch, and of a quality not easily affected by contact with water.

Rankine, in his work on Civil Engineering, page 721, assumes iron of a tensile strength of fifteen thousand six hundred pounds per square inch, a factor of safety of six beyond which the pipe should not be strained; and in making up his formulas for thickness of pipe makes a further allowance for the difficulties in casting and for the strain produced by shocks. D'Aubisson, in his work on Hydraulica, page 231, says: "The custom is to give to material employed in their constructions such dimensions, at least, that the effort they will have to sustain will cause no permanent alteration in them; this effort is estimated for cast-iron pipe at from two and one-half to three and one-half times less than what would cause rupture;" and for greater security he assumes four and two-tenths. He also assumes that the pipe may be subjected to shocks or strains equal to ten atmospheres, or three hundred and twenty-eight feet in addition to its static head, and he so estimated. Latham, in his work on Sanitary Engineering, says, on page 30: "The safe load for cast iron should not exceed one-tenth the breaking weight," and that the test to which the pipe is subjected is equal to ten times the working head. Kirkwood, engineer of the Brooklyn Water Works, estimates the ram or shock to which pipes are subjected to be five times the static head.

P. H. Baerman, in a paper read before the Engineers' Club of Philadelphia, March 4, 1882, after a very careful review of the method of reasoning of various persons writing upon this subject, concludes that iron pipe should in no case be subjected to a greater strain than one-fifth of its ultimate strength, and that the maximum pressure to which a pipe is subjected is at least two and one-half times the static head. A. H. Howland, in his paper previously referred to, concludes the limit of safety to which pipes should be subjected to be one-fifth the ultimate strength, and has compiled a very valuable set of tables showing the minimum thickness of pipe of various sizes at which they can be safely cast and handled; the thickness in inches, weight of pipe, and head or pressure which the pipe cast from iron of various tensile strength will stand.

The accompanying diagrams show the weight of the various sizes of pipes in use as compiled from returns received, together with a comparison of the weights as deduced from the various formulas, based upon a static head or pressure of one hundred pounds and iron with a tensile strength of eighteen thousand pounds. They may prove an interesting study, and being a ready means of comparison, may prove of value in the more careful study of the question in the future.

In conclusion, I would suggest that a committee of this Association be appointed to look into the question of the proper thickness of cast-iron pipe for general practice, greater uniformity of specifications as to quality of iron and general details. I feel that such a committee could collate such information and reach such conclusions as would be of great value to the Association.

[For Discussion of this Topic, see page 28.]

YOUNG'S HOTEL, BOSTON, MASS.,
Jan. 29, 1885.

A special meeting of the Association was holden here this day, being called to order by President Geo. A. Ellis at eleven o'clock, A. M.

A call of the roll showed the following named gentlemen present:

ACTIVE MEMBERS.

Geo. E. Batchelder,	Registrar,	Worcester, Mass.
Wm. R. Billings,	Superintendent,	Taunton, Mass.
J. Henry Brown,	Supt. Charlestown District,	Boston, Mass.
Robert C. P. Coggeshall,	Superintendent,	New Bedford, Mass.
Edwin Darling,	Superintendent,	Pawtucket, R. I.
George A. Ellis,	City Eng'r & Registrar,	Springfield, Mass.
Albert S. Glover,	Registrar,	Newton, Mass.
Robert M. Gow,	Superintendent,	Medford, Mass.
Frank E. Hall,	Superintendent,	Quincy, Mass.
James H. Hathaway,	Registrar,	New Bedford, Mass.
William F. Hill,	Superintendent,	Dedham, Mass.
Horace G. Holden,	Superintendent,	Lowell, Mass.
David W. Horan,	Superintendent,	Clinton, Mass.
A. H. Howland,	Engineer,	U. S. Hotel, Boston, Mass.
Horatio N. Hyde, Jr.,	Superintendent,	Newton, Mass.
Nathaniel I. Jordan,	Treasurer,	Auburn, Maine.
Charles W. Morse,	Superintendent,	Haverhill, Mass.
Hiram Nevons,	Superintendent,	Cambridge, Mass.
Albert F. Noyes,	City Engineer,	Newton, Mass.
Walter H. Richards,	Superintendent,	New London, Conn.
Henry W. Rogers,	Superintendent,	Lawrence, Mass.
Phineas Sprague,	Registrar,	Malden, Mass.
Lucien A. Taylor,	Commissioner,	Worcester, Mass.
Wm. C. Wilcox,	Registrar,	Waltham, Mass.

FINE MEMBERS.

Equitable Water Meter Co.,	Boston, Mass.
Wilbur D. Fiske, Agent Knowles Steam Pump Co.,	Boston, Mass.
National Meter Co.,	New York, N. Y.
Henry R. Worthington,	New York, N. Y
Union Water Meter Co.,	Worcester, Mass.

VISITORS.

H. Q. Sanderson,	Chairman Water Board,	Springfield, Mass.
Foster S. Dennis,		New Bedford, Mass.
Amos Pettingill,	Superintendent,	Woburn, Mass.
Walter H. Harding,	Registrar,	Cambridge, Mass.
L. Luville Gerry,	Superintendent,	North Attleboro, Mass.
George B. Ferguson,	of H. R. Worthington,	Boston, Mass.

The records of the last meeting of the Association were then read by the Secretary and approved.

Applications for membership from the following named gentlemen were then received:

FOR ACTIVE MEMBERSHIP.

F. F. Forbes,	Superintendent,	Brookline, Mass.
Amos Pettingill,	Superintendent,	Woburn, Mass.
Walter H. Harding,	Registrar,	Cambridge, Mass.
L. Luville Gerry,	Superintendent,	North Attleboro, Mass.

FOR FINE MEMBERSHIP.

George B. Ferguson, agent H. R. Worthington & Co.,	Boston, Mass.
A. M. Morton, Gas, Steam and Water Pipes,	Boston, Mass.

The Executive Committee considered these applications and reported favorably upon all, and, the report being accepted, upon motion of Mr. Horan of Clinton, the Secretary was instructed to cast one ballot for all the above named candidates, which being done they were declared by the

President to have been elected members of the Association.

The President then addressed the Association as follows:

GENTLEMEN OF THE NEW ENGLAND WATER WORKS ASSOCIATION:

Our Constitution provides for two classes of meetings, annual and special; hitherto we have confined ourselves to annual and fall meetings, the latter given up wholly to sight-seeing and personal enjoyment.

In Article 1, Section 2, the object of our Association is stated to be:

"The promotion and advancement of knowledge, scientific and practical, in all matters relating to the construction and management of "Water Works" and the distribution and consumption of water, the establishment and maintenance of a spirit of "fraternity" between the members of the Association by social intercourse, and by friendly interchange of information and ideas on the before-mentioned subject."

It is the latter part of this Section to which your attention is called.

In our annual meetings, the formal transaction of necessary business, the reading of papers on topics assigned, and the sight seeing which has come to be almost a part of these occasions, has left us little time in which to cultivate the spirit of "Fraternity" or to engage in that "Friendly interchange of information and ideas" required to lift us to the highest plane of practical associate existence.

A friendly interchange of ideas, as between friends, is different from that received in scientific discussion, in that we are enabled to get at a greater amount of detail and a better defined opinion. In short, we are placed in full possession of the experience and thoughts of our friends.

The Executive Committee have therefore thought best to make a new departure and have called a special meeting at this time, in which, freed from all extraneous interests or the rules of formal discussion, members can freely say to each other how this or that device works with them, why they like it or why they do not. Questions upon which we need personal information and which can be discussed in private conversation without committing the Association to the beliefs of any individual, but shall simply serve to disseminate the experience of each for the aggregate information of the whole.

Different members use different devices for tapping under pressure; let us know the advantages and disadvantages of each device. It is hard learning, unless those who have already learned by hard experience are willing to show us the shoals which we need to steer clear of, and we have a clear right to demand of such of them as are our associates, that they will, in a friendly way, give us the advantage of their knowledge.

Many devices have been introduced to assist us; who will tell us about them? How about the patent device to do away with the clayed coil in running a joint? Is it worth its cost and how long will it last? How about diaphragm pumps to clear the ditch in case of a break, how many have used them and how many are afraid of the cost of getting one?

In the clerical work of the department, we wish to know how others manage, what methods of accounting are resorted to.

Is it advisable for the department to collect its own charges or can the public be best served through the tax collector? Should payment on all but meter rates be collected in advance, and if so, for how long a time?

These and many a score of other questions are constantly recurring in different forms and places; if we can get at the experience of those who have studied the question, is it not better than to pay the penalty of sad experience for our own ignorance? What we need to learn is the experience of our associates, and how can this be accomplished in any easier manner than that pointed out in our Constitution: The friendly interchange of information. I bespeak your careful thought upon this point. Let us each give our best and be not ashamed to ask. It is related that one noted for his learning, when questioned how he obtained it, replied that he never was ashamed to ask the reason of anything he did not understand or to solicit the advice of those especially qualified to give information upon any subject in which he was interested.

So with our members, gathered from every State in New England; we have specialists upon almost every subject of interest to water works men; what we need is this friendly interchange of information that shall add to the amount possessed by each.

I wish to impress this feeling of friendliness and fraternity, not that we have been deficient in this respect, but it is desirable to increase this feeling to the extent that what is known by one shall be at the disposal of all; in fact, that we follow the definition of friends as laid down by the greatest who ever walked on earth, "But I have called you friends; for all things I have heard . . . I have made known unto you."

The Executive Committee then presented its recommendation, adopted at a meeting holden in August, 1884, in regard to amending the Constitution and By-Laws; the recommendation was as follows: "That Article III of the Constitution and By-Laws be changed so as to read:

ASSOCIATE MEMBERS.

SECTION 1. Persons or firms engaged in furnishing materials for the construction and maintenance of Water Works desiring to join the Association may be admitted as members by the usual form on the payment of ten dollars; their annual dues shall be five dollars and they shall be entitled to one representative at each meeting, but shall not be entitled to vote or take part in any discussion unless permission be given by the meeting.

Voted, That the recommendation be adopted.

Mr. Hall of Quincy, for the Committee appointed to consider the matter of the tender by our Association of some courtesy to the American Water Works Association, on the occasion of their Convention to be holden in Boston, April 21, 22, and 23, then reported. He said that the Committee were unanimously of the opinion that some official courtesy on our part was called for, and also that such courtesy could be extended in the best, pleasantest, and most convenient manner by a dinner to be given at some Boston hotel; the Committee would therefore recommend that arrangements be made by our Association to give a dinner to the American Association, and that towards defraying the expense thereof an assessment of two dollars, be levied upon each member of the Association.

The report was discussed by Messrs. Darling of Pawtucket, Glover of Newton, Kelley of New York, Fiske of Boston, Howland of Indian Orchard, Morse of Haverhill, Billings of Taunton and Brown of Boston, and finally upon motion of Mr. Horan of Clinton it was Voted: That the report be accepted and its recommendation be adopted and an assessment of two dollars, towards defraying the expense thereof, be levied by the Secretary upon each member of the Association, both Active and Associate.

Upon motion of Mr. Howland, of Indian Orchard, it was Voted:

That the whole matter of entertaining the American Association be left with the Committee who have thus far had charge of the matter and that they be empowered to add to their number two of the Associate members. Under the authority of this vote Messrs. Jason Giles of the Chapman Valve Manuf'g Co. and Wilbur D. Fiske, Agent Knowles Steam Pump Co., Boston, Mass., were subsequently joined to the committee.

Voted, On motion of Mr. Hall of Quincy, that the address of the President be printed in full in the records of the proceedings of this meeting of the Association.

Mr. Coggeshall of New Bedford then addressed the Convention as follows:

Mr. PRESIDENT AND GENTLEMEN: I wish to call the attention of our friends to a matter in which we are all interested and concerned. In a casual way some of us have already discussed it and I think perhaps the right time has now come for us as an Association, at least, to consider it.

At our first annual meeting at Worcester we were most hospitably entertained by its citizens, and also our friends at Springfield and Indian Orchard came in for a share of our thanks. Then at Pawtucket the following fall, the impression was made that in a friendly way they were determined to be a little more lavish with their hospitality than was evinced at the previous meeting. Last June our Lowell friends had their turn and we can all testify to the kind treatment we received while we were their guests. Finally came the day with our Newton friends with its elegant programme of sight-seeing and banquets. Thus at each successive place, I think, we may easily note a friendly effort of hospitality displayed to surpass in extent that of the preceding gathering.

None have more thoroughly enjoyed these gatherings than I, yet the thought occurs whether or not the efforts of our friends, if continued in this direction, would not really be detrimental to the general prosperity of our organization. Already those who represent places where we soon may wish to gather hint that such an occurrence would place them in an embarrassing position. *Why?* Simply because it would be impossible to place before us an entertainment of such variety as has been done in the past. Now it seems to me that such a feeling on the part of any of our members can but command respect. The member who represents the humblest water works on our list may have had (and such members often do have) an experience with some matter that we all shall be glad to know about, and we are pleased to hear him relate it that we may profit by it. That is really one of the prime objects of these gatherings, as I understand it. The means this member has at command are limited. The time arrives when we are to meet at his place He is glad to receive us, but to provide an entertainment of much variety is utterly out of the question. It is partly in the interest of such members as these that I wish the Association to consider this matter. The number of places where it is possible to carry out an extended programme are few and they soon will be stricken from our list; we shall then wish to gather together at some of the smaller places with those who exhibit just as hospitable feelings and among whom it will take full as great an effort on their part to carry out their programme. Mr. President, the way should be provided that their task may be a pleasant one and not too much of a burden.

Again, members of our various Boards occasionally meet with us. If the present state of things should be continued will there not be a danger that they will receive the impres-

sion that the real object of our gatherings is of the nature of a "junketing" trip and consequently withheld from us that sympathy and aid which they can render.

Next June we meet at Springfield. Already we are indebted to our friends at that place, and certainly none of us would expect or wish that an elaborate entertainment should be provided at that time. Here is a splendid opportunity for our Committee having the matter in charge to make somewhat of a change in the programme of the Convention in this respect. Would it not be well to devote a longer space to the actual objects of our organization? I feel that such a proceeding would result in much good to our individual members.

I would now very much like to hear the views of some other of our members on the subject.

The subject introduced by the remarks of Mr. Coggeshall was then discussed by Messrs. Giles, Richards and Howland, who favored the adoption of a programme excluding everything but the most simple hospitality from the place in which we may hold our meetings, and by Messrs. Darling and Nevons, who opposed any change in our customary plans, the two latter gentlemen stating that while they believed as strongly as any others in the business part of our meetings and realized that it was for business and not pleasure that our Association was organized, they felt that the acceptance of tendered hospitalities would be only courteous on our part and would not only not tend to injure our Association but on the contrary would have the reverse tendency, as oftentimes in the acceptance of such courtesies much of benefit, especially in the way of inspection of works, would be gained.

Mr. Hall moved that the Committees having charge of the arrangement of our meetings act in all cases with the sole

idea that our meetings are intended for business; and that no tender of courtesies be considered till said business programme be carried out.

Mr. Darling opposed the motion and hoped it would not be pressed. He said he thought it would only embarrass the committees of arrangements, and they should be allowed the same discretion they had heretofore had. He hoped this whole matter would now be dropped without a vote being taken, being satisfied in his own mind that there was no member of the Association who would have so little respect for his fellow members as to think them unwilling to visit and inspect his works without the inducement of a "junket."

Mr. Hall then withdrew his motion, stating that he only made it to draw out the views of the Association in the matter, and that he felt that perhaps all that had been desired had been accomplished by the discussion which had occurred.

The Convention then took a recess, and for about an hour the members indulged in general conversation.

At two o'clock dinner was announced, and twenty-five members spent an hour and a half in its consideration. At the end of that time President Ellis rapped to order, and after a neat speech severally called upon Messrs. Darling, Taylor, Jordan, Brown, Richards, Noyes, Glover, Hathaway, Coggeshall, Holden, Horan, Howland, Sanderson and Wilcox; after brief remarks by these gentlemen the Convention at four o'clock adjourned.

ALBERT S. GLOVER,
Secretary.

APRIL MEETING.

YOUNG'S HOTEL, BOSTON,
April 21, 1885.

A special meeting of the Association was holden here at 9.30 A. M. this day. President Ellis in the chair.

The Secretary read the following list of names of applicants for membership:

Active:—B. H. Hull, C. E., Bridgeport, Conn.; H. F. Whidden, Commissioner, South Abington, Mass.; C. W. S. Seymour, Supt., Hingham, Mass.; W. H. Barney, Supt., Milford, Mass.; B. S. Babcock, Supt., Nashua, N. H.; J. C. Broatch, Supt., Middletown, Conn.; George A. Stacy, Supt., Marlboro', Mass.; Col. J. T. Fanning, C. E., Manchester, N. H.; W. F. Codd, Supt., Nantucket, Mass.; A. W. Inman, Supt., South Weymouth, Mass.; Willard Kent, Supt., Woonsocket, R. I.; Dexter Brackett, Asst. City Engineer, Boston, Mass.; H. F. Davis, Supt., Athol, Mass.; S. C. Heald, C. E., Worcester, Mass.; J. H. Caldwell, Registrar, Mystic Div., Boston, Mass.; Albert B. Drake, City Surveyor, New Bedford, Mass.; W. F. Learned, Resident Engineer, Ashland Basins, Boston Water Works; D. Fitzgerald, Supt. Western Division, Boston Water Works; Chas. Fred. Crehore, Commissioner, Newton, Mass.; A. E. Martin, Supt., Framingham, Mass.; Col. A. A. Haggett, Commissioner, Lowell, Mass.; F. H. Parker, Supt., Burlington, Vt.

Associate:—D. Brainerd Spooner, Boston, Mass.; Chadwick Lead Works, Boston, Mass.; Benj. C. Mudge and E. Harley Gowing, of H. R. Worthington & Co., Boston, Mass.; Jason Giles, Chapman Valve Mfg. Co., Boston, Mass.; Curtis Regulator Co., Boston, Mass.; Cunningham Iron Works Co., Boston, Mass.; Deane Steam Pump Co., Holyoke, Mass.;

Albert B. Franklin, Boston, Mass.; Randolph Brandt, New York City; Jarvis Engineering Co., Boston, Mass.; National Tube Works Co., Boston, Mass.; D. Goffe Phipps, New Haven, Conn.; Tuerk Motor Co., New York City; Walworth Mfg. Co., Boston, Mass.; Asbestos Packing Co., Boston, Mass.; Boston Lead Co., Boston, Mass.; Geo. Woodman & Co., Boston, Mass.; Henry F. Jenks, Pawtucket, R. I.; Waldo Brothers, Boston, Mass.; Pattee & Draper, Holyoke, Mass.; Sumner & Goodwin, Boston, Mass.; John T. Langford, Boston, Mass.; Jenkins Bros., Boston, Mass.; W. H. Ward and Thomas Curley, of Ward & Curley, Boston, Mass.; Peet Valve Co., Boston, Mass.; Frost & Adams, Boston, Mass.

The Secretary stated that the applications had all been considered and favorably acted upon by the Executive Committee. It was thereupon voted that the Secretary cast one ballot for all applicants whose names he had just read; the Secretary having done so the President declared the candidates elected to membership in the Association, after which a motion to adjourn was made.

MEETING WITH AMERICAN ASSOCIATION.

Immediately after adjournment the Association assembled together with the American Water Works Association in the upper dining hall of the hotel. President Gardner of the American Association in the chair. After calling the convention to order President Gardner felicitously introduced President Ellis who spoke as follows:

Gentlemen of the American Water Works Association: — The New England Water Works Association bids you welcome. We fraternally greet you and hope the hours you may spend with us may and will redound to our mutual benefit. I now have the pleasure of introducing to you His Honor, Mayor O'Brien, of Boston.

Mayor O'Brien was received with hearty applause and spoke as follows:

Gentlemen: — I will merely say at the present time that the city of Boston is very much gratified at your visit and hopes that it may be a very pleasant one. We like to have visitors from different sections of the country leave us with favorable impressions. We shall do all we can to have you go to your homes carrying with you pleasant recollections of your visit. The water question with us is, perhaps, the most important that our City Government has to consider at the present time; and while your visit is very gratifying to us we hope to derive considerable benefit from your experience and knowledge of the water supply of the country. I will merely at this time say, or rather repeat, that I hope your visit will be a pleasant one and assure you that we shall do all in our power to make it so. [Applause.]

To the remarks of the mayor President Gardner made a fitting response, after which the mayor held a short reception; upon his withdrawal, President Gardner called the Association to order, and the roll having been called Secretary Decker offered the following resolution:

Whereas, The American Water Works Association enjoys the pleasure of coming at this time within the boundaries of the New England Water Works Association, for which Association and for whose members we entertain the highest esteem, respect and confidence;

Resolved, That the members of the New England Water Works Association be and they are hereby cordially invited and requested to occupy seats with us during our convention and to join us in the discussion of the papers read during our sessions.

To this resolution, which was unanimously adopted, President Ellis responded as follows:

Mr. President:

The New England Water Works Association thanks you for the resolution just passed and again begs your attention to ask you to accept, as a token of their interest in the same work with you, this room and the Committee rooms adjoining, during your session here; and they ask you further, to meet them at a reception and dinner to be given in your honor in this room and rooms below, this evening at 6.30 o'clock.

President Gardner, in behalf of the American Association, accepted this invitation, and at the request of President Ellis, Secretary Glover read the following programme which he stated had been arranged by the committees, of the two Associations, appointed for the purpose.

AMERICAN WATER WORKS ASSOCIATION.

FIFTH ANNUAL CONVENTION,

BOSTON, MASS., APRIL 21, 22, AND 23, 1885.

HEADQUARTERS OF ASSOCIATION DURING THE CONVENTION WILL BE AT

YOUNG'S HOTEL.

COMMITTEE ROOMS:

AMERICAN ASSOCIATION	ROOM 11.
NEW ENGLAND ASSOCIATION	" 13.
ASSOCIATE MEMBERS	ROOMS 6 AND 7.

Meetings of the Convention will be held in Room 12.

Members of the American and New England Associations, and Guests of the Convention, will please report at the office of the Secretary of the New England Association, Room 13, immediately upon arrival, where they will be provided with badges, which they are requested to wear during the Convention. They will also apply at said office for Excursion and Dinner Tickets.

BADGES ADOPTED FOR THE MEETING.

American Association, *White Bow.*
New England Association, *Red Bow.*
American and New England Associations, *Red and White Bow.*
Committee of American Association, *White and Blue Bow.*
Committee of New England Association. *Red and Blue Bow.*
Committee of both Associations, *Red, White and Blue Bow.*
Guests, *Pink and White Bow.*

Members and Guests will please notify the Secretary of the New England Association, at as early a date as possible, of their intended participation in the various excursions.

MEETINGS.

TUESDAY, APRIL 21, 1885,

9 o'clock, A. M.

Business Meeting of the New England Association. The Convention will assemble in Room 12, at 10 A. M., when it will be received by the Hon. Hugh O'Brien, Mayor of Boston.

OPENING EXERCISES.

ORDER OF BUSINESS.

AFTERNOON SESSION—2 O'CLOCK.

READING AND DISCUSSION OF PAPERS.

"Water Waste in its Different Phases." *Peter Milne, Jr.*
"Rules and Regulations." *C. H. Brown.*
"Self-Closing Plumbing Work." *W. C. Stripe.*
"Steam Boilers and their Settings." *P. H. Linneen.*

6.30 O'CLOCK, P. M.

RECEPTION AND DINNER

TENDERED BY

THE NEW ENGLAND WATER WORKS ASSOCIATION.

WEDNESDAY, APRIL 22, 1885,

8.30 O'CLOCK, A. M.

Exhibition of the operation of the Deacon Meter, and Church Stop-Cock Waste Detector, at Pipe Yard of Boston Water Works, 221 Federal Street, by invitation and under the direction of Dexter Brackett, Assistant Engineer in charge of Boston Water Works.

ORDER OF BUSINESS.

MORNING SESSION—10 O'CLOCK.

RECEPTION OF REPORTS.

READING OF PAPERS.

"Pumping Engines." *John W. Hill, Wm. B. Sherman, Wm. D Hooker.*

"Kalamein Pipe." *J. M. Carson, Frank Schefold, H. G. Holden.*

"Tests of Steam Coal. *J. G. Briggs, J. W. Hill.*

AFTERNOON SESSION—2 O'CLOCK.

READING OF PAPERS.

"What is Perfect Duty?" *Wm. Golden.*

"Cast-Iron Pipe." *A. H. Howland.*

"Difficulties Encountered with Plumbers." *W. L. Cameron.*

"Street Mains." *G. A. Ellis.*

EVENING SESSION—8 O'CLOCK.

READING OF PAPERS.

"Railroad Water Supply." *B. F. Jones.*

"Annual Reports." *J. J. R. Croes, Chas. G. Rice.*

"Rules Governing Duty Tests." *A. G. Moore.*

QUESTIONS AND ANSWERS

THURSDAY, APRIL 23, 1885.

REGULAR ORDER OF BUSINESS.

MORNING SESSION — 10 O'CLOCK.

ELECTION OF OFFICERS.

ADJOURNMENT.

Through the courtesy of various officials of the City of Boston, a visit to the Public Institutions and Improved Sewerage Works in the City of Boston will be made. Members and guests will leave Young's Hotel at 10.30 A. M. Steamer will start from North Ferry, city side, at 11 A. M. After a short trip around the harbor, a landing will be made at Deer Island. Lunch will be served on board the boat. After visiting the Public Institutions on Deer Island, the steamer will proceed to the Pumping Station of the Improved Sewerage System. An hour will be spent at this point, after which a trip will be made to Moon Island, where the Outfall Reservoir is situated. The steamer will then return to the city, arriving at about 5.30 P.M.

MEMBERS WILL PLEASE PROVIDE THEMSELVES WITH TICKETS.

COMMITTEE OF THE DAY.

Desmond Fitzgerald, Supt. Western Division B. W. W.

Elliot C. Clarke, Constructing Engineer of Improved Sewerage Works.

Benjamin C. Mudge, representing Henry R. Worthington Steam Pump Works.

EXCURSIONS.

The Convention and Guests are cordially invited to participate in the following Excursions: on

FRIDAY, APRIL 24, 1885,

Excursion to Boston Water Works, by invitation of Boston Water Board.

Party, in charge of Boston Water Board, and Desmond Fitzgerald, Supt. of Western Division B. W. W.,

Leave Young's Hotel at 8.10 A. M., Boston & Albany R. R. Depot at 8.30. Upon arrival at South Framingham the party will take carriages to Basin 4 of the Sudbury River System. Time will be given for the examination of the dam in course of construction at this point. Return to South Framingham will be made in time to take the 12 o'clock train for Auburndale. Carriages will be taken at the Auburndale Station and be driven through Hancock Street, Woodland Avenue, and Washington Street to Woodland Park Hotel, where they will be joined by Party No. Two, and lunch served by the courtesy of the New England Water Works Association.

Drive and Visit to various Water Works in the Vicinity of Boston, by Invitation of the New England Water Works Association.

Party will take carriage at Young's Hotel at 8.10 A. M., in charge of J. Henry Brown, Supt. of Mystic Division, B. W. W.

Route.—Court, Washington, and Charlestown Streets. Charles River Bridge, City Square Park, and Winthrop Street to Bunker Hill Monument. Leave Bunker Hill Monument at 8.50 o'clock. Thence by Monument Avenue, Main Street and Broadway, by Tufts College to Mystic Reservoir; leave Reservoir at 9.20. Thence to Mystic Pumping Station.

Party, in charge of Hiram Nevons, Supt. Water Works, and Wm. S. Barbour, City Engineer of Cambridge.

Leave Mystic Pumping Station at 9.45 o'clock. Leave Cambridge Pumping Station at 10.40. Leave Cambridge Reservoir at 11 o'clock. Thence to Mount Auburn Street, Coolidge Avenue, and Arsenal Street, crossing Charles River, Market Street to Chestnut Hill Reservoir; leave Chestnut Hill Reservoir at 11.40.

Party, in charge of Albert S. Glover, Water Registrar, and H. Nelson Hyde, Jr., Supt. Newton Water Works.

Thence by South and Ward Streets to Waban Hill Reservoir, Newton Water Works. Leave Waban Hill at 12 o'clock. Thence by Ward Street, Waverly Avenue, Sargent Street, Centre Street, Newtonville Avenue, Walnut Street, Highland Avenue, Mount Vernon Street, Hillside Avenue, Otis Street, Chestnut Street, Highland Street, Temple Street, Prospect Street, Washington Street to Woodland Park Hotel, where the party will be joined by Party No. One, and Lunch will be served. Leave hotel at 2 o'clock. Thence by Washington, Beacon, Woodward, Chestnut, Boylston and Ellis Streets to Echo Bridge of the Sudbury River Aqueduct of the Boston Water Works. Leave Echo Bridge at 2.40 o'clock. Thence by Ellis, Chestnut, Oak and Needham Streets to Filter Basin and Pumping Station of Newton Water Works. Leave Pumping Station at 3.10 o'clock. Thence by Oak, High, Summer and Chestnut Streets to Echo Bridge. At this point the party will again divide, and such as may desire will take boats for a sail through the Sudbury River Aqueduct and Tunnel to Chestnut Hill Reservoir, party being in charge of Boston Water Board and Desmond Fitzgerald. Those who do not go through the Conduit will take carriages and proceed to Chestnut, Boylston, Hartford, Lincoln, Walnut Streets, Lake Avenue and Beacon Street to the Gate House of the Sudbury River Aqueduct at Chestnut Hill Reservoir, where they will receive the first party. From this point the parties will again join and examine the Gate Houses and meteorological apparatus, and Chestnut Hill Reservoir, leaving Reservoir at 5 o'clock. Thence by Reservoir Avenue, Boylston and Washington Streets and Highland Place to Parker Hill Reservoir; leave Parker Hill Reservoir at 5.30, Thence to Boston, reaching Young's Hotel at about 6 P. M.

COMMITTEEE OF THE DAY.

Albert F. Noyes, City Engineer, Newton, Mass.
Desmond Fitzgerald, Supt. of Western Division B. W. W.
Charles H. Baldwin, Equitable Water Meter Co.
Benj. C. Mudge, Worthington Steam Pump Works.

On motion of Secretary Decker an invitation was then extended to the members of scientific and technical schools, the Boston Society of Civil Engineers and the Society of Mechanical Engineers to meet with the convention during the session.

Numerous letters of regret at inability to attend the convention were then read by Secretary Decker, after which the convention adjourned until 2 o'clock, P. M.

Afternoon Session, Tuesday, April 21.

The convention was called to order at 2 o'clock, P. M. President Gardner in the chair.

The Secretary presented a list of sixteen Active and three Associate applicants, who were balloted for and elected to membership in the Association.

Reports of the Secretary and Treasurer and Executive Committee were then received and accepted.

The following named papers were then read and discussed.

Water Waste in its Different Phases, Peter Milne, Jr.

Rules and Regulations, C. H. Brown.

Self-closing Plumbing Work, W. C. Stripe.

Steam Boilers and their Settings, P. H. Linneen.

The convention then adjourned to 6.30 o'clock, P. M.

Reception and Complimentary Dinner to the American Association.

At half past six o'clock the members began to gather to pay their respects to His Excellency Governor Robinson and His Honor Mayor O'Brien, who were holding a reception in the private parlors of the Hotel. Besides the members of the two Associations there were present very many guests,

and the parlors and hotel corridors presented a very animated appearance. After about an hour had been spent in the introduction to the Governor and Mayor of the distinguished guests from abroad the Association and its guests proceeded to the large banquet hall which had been handsomely prepared for the occasion. At each plate had been placed a *menu* for service, ornamented with a choice boutonniere and accompanied by an elegant souvenir menu finely illustrated with original designs. The tables were beautifully decorated with flowers, and music by Carter's orchestra added greatly to the enjoyment of the occasion. President Ellis presided, having on either side President Gardner of the American Association and Governor Robinson, while in close proximity sat Mayor O'Brien. Gathered about the tables were the following named gentlemen:

Speaker Brackett of the Mass. Legislature; Senator Wells and Representative Whipple of the Legislative Committee on Water Supply; Mayors Doyle of Providence, Rotch of New Bedford, and Kimball of Newton; Water Commissioners Haggett of Lowell, Kingsley of Cambridge, Simmons, Blake and Hobbs of Boston, Wadleigh of Haverhill, Moulton of Lawrence, Wilder of Malden, Smith of Salem, Cate of Newton, Harris of Waltham, Darling of Pawtucket, Faxon of Quincy, Foss and Corcoran of Clinton and Jordan of Auburn, Me.

Prof. Vose of Massachusetts Institute of Technology Eliot C. Clark of the Improved Sewerage System of Boston, Prof. Geo. F. Swaine of the Institute of Technology, Hon. R. M. Pulsifer of the Boston Herald, L. F. Rice, H. L. Eaton and Henry Manley representing the Boston Society of Civil Engineers, A. T. Whiting chairman Committee on Public Institutions of Boston, Hon. S. B. Stebbins, Boston, Col.

John T. Wyman of Valley Falls, R. I., Col. Olney Arnold o Pawtucket, R. I.

Supt. Andrew, Central Falls, R. I.; Phineas Ball, C. E. of Worcester; J. J. R. Croes, C. E. of New York City; Supt. Decker of Hannibal, Mo.; Supt. Denman of Des Moines, Iowa; Treasurer Divin, Elmira, N. Y.; Supt. Donahoe, Davenport, Iowa; H. F. Dunham, C. E. of Cleveland, Ohio; Supt. Dunbar, Bay City, Mich.; Secretary Espy, Wilkesbarre, Pa.; F. L. Fuller, C. E., Boston; I. A. Holly, C. E., New Haven, Conn.; F. W. Holly, M. E., Lockport, N. Y.; Supt. Jones of New Brunswick, N. J.; Supt. McMinn, Williamsport, Pa.; Chief Engineer McIntire, Wilmington, Del.; Water Purveyor Milne, Brooklyn, N. Y.; Supt. Milner, Birmingham, Ala.; Supt. Molis, Muscatine, Iowa; Supt. Moore, Phœnixville, Pa.; President Perkins, Springfield, Mo.; Supt. Randall, East Orange, N. J.; President Ryle and Supt. Ryle of Paterson, N. J.; A. C. Seckell, Engineer, Grand Rapids, Mich.; G. C. Stevens, C. E., Newport, R. I.; H. D. Wood, Secretary, St. Louis, Mo.; Registrar Batchelder, Worcester, Mass.; Supt. Billings, Taunton, Mass.; Ass't. City Engineer Brackett, Boston; Supt. Brown, Mystic Division, Boston; Registrar Caldwell, Mystic Division, Boston; Supt. Chase, Wilmington, N. C.; Supt. Clark, Northampton; Supt. Codd, Nantucket; Supt. Coggeshall, New Bedford; Supt. Cutts, Meter Division, Boston; Supt. Darling, Pawtucket, R. I.; Supt. Dennett, Somerville; City Surveyor Drake, New Bedford; Supt. Gerry, No. Attleboro; Supt. Gow, Medford; Supt. Granniss, New Haven; Supt. Hall, Quincy; Supt. Hancock, Springfield; Registrar Hathaway, New Bedford; Supt Hawkes, Malden; Supt. Hill, Dedham; Supt. Holden, Lowell; Supt. Horan, Clinton; A. H. Howland, C. E., Boston; Supt. Hyde, Newton; Treasurer Jordan, Auburn, Me.; President Joy, Milford; Supt. Lane, Melrose; W. F. Learned,

Resd't Engineer in charge, Ashland Basins, B. W. W.; Ex-Supt. Lyon, Lynn; Supt. Morse, Haverhill; Supt. Nevons, Cambridge; Engineer Noyes, Newton; Supt. Parker, Burlington, Vt.; Supt. Richards, New London, Conn.; Supt. Rogers, Lawrence; Clerk Russell, Everett; W. B. Sherman, C. E., Providence, R. I.; Supt. Stacy, Marlboro; Commissioner Taylor, Worcester; M. M. Tidd, C. E., Boston; Clerk Wilcox, Watertown; Horace B. Winship, C. E., Troy, N. Y.; E. R. Jones, Supt., Boston; H. A. Carson, C. E., Boston; representatives of the business firms of the Asbestos Packing Co., Boston; Ashton Valve Co., Boston; Chadwick Lead Works, Boston; Geo. F. Blake Mfg. Co., Boston; Boston Lead Co., Boston; Randolph Brandt, New York City; Chapman Valve Co., Boston; Cunningham Iron Works, Boston; Ward and Curley, Boston; Deane Steam Pump Co., Holyoke; Equitable Water Meter Co., Boston: Frost and Adams, Boston; Chapman Valve Mfg. Co., Boston; Henry F. Jenks & Co., Pawtucket, R. I.; Knowles Steam Pump Co., Boston; John T. Langford, Boston; Ludlow Valve Co., Troy, N. Y.; Tuerk Motor Co., New York City; National Meter Co., New York City; National Tube Works, Boston; Pattee and Draper, Holyoke; Peet Valve Co., Boston; Geo. H. Sampson, Boston; Sumner & Goodwin, Boston; Union Water Meter Co., Worcester; Waldo Brothers, Boston; Walworth Mfg. Co., Boston; R. D. Wood & Co., Philadelphia, Pa.; Geo. Woodman & Co., Boston; H. R. Worthington, New York City; A. W. Morgan, Buffalo, N. Y.; P. Connelly, New York City; W. S. Payne, Titusville, Pa.; Ripley & Kimball, St. Louis, Mo.; and others making a gathering of about two hundred gentlemen.

The Menu prepared for the occasion was as follows:

DUTY TEST

OF THE

AMERICAN WATER WORKS ASSOCIATION,

BY THE

NEW ENGLAND WATER WORKS ASSOCIATION.

MENU.

SHELL FISH.

Blue Points. Little Necks.

SOUPS.

Green Turtle. Consomme Jardiniere.

SHERRY.

FISH.

Penobscot Salmon, Hollandaise Sauce.

Cucumbers. *Green Peas.*

SAUTERNE.

REMOVES.

Spring Lamb, Mint Sauce. Fillet of Beef, aux Champignons.

Roast Larded Spring Chicken.

APOLLINARIS.

ENTREES.

Sweet Breads aux Petits Pois. Vol au Vent a la Financiere.

Croquettes of Chicken, Sauce Supreme. Cutlets of Lobster a la Cardinal.

Macaroni Parmesan au Gratin.

SCHREIDER.

RELEVE.

Frozen Tom and Jerry. Cigarettes.

GAME.

Red Head Duck. Bluebill Widgeon. English Snipe.

SWEETS.

Souffle Parisien. Frozen Pudding. Charlotte Russe.

Biscuit Glace. Cafe Pafe. Madeira Jelly.

DESSERT.

Strawberries. Oranges. Bananas. Raisins. Nuts. Figs.

Candied Fruits. Ice Cream. Sherbet.

Crackers. Coffee. Cigars.

YOUNG'S HOTEL, BOSTON, APRIL 21, 1885.

Several hours were occupied in conforming to the required "tests" and when at last cigars were reached, President Ellis, rapping to order, opened the post-prandial exercises as follows:

REMARKS OF PRESIDENT GEORGE A. ELLIS.

"A quarter of a century ago a gathering like this which we have here this evening would have been simply impossible. Impossible, not only because there were no associations of water works men in existence, but all the water works of our country, beyond those of some mountain springs, might have been counted on the fingers of one's two hands. I remember reading that at the world's Crystal Palace exposition in England the exhibits of semi-barbaric Russia excelled those of our own country in their contributions to luxury and ease. Whatever may be our relative conditions today, it is a matter of common knowledge that the growth of America in this direction during the last generation has been something wonderful.

"One has said that, show him the roads of a country, he would tell the degree of its civilization. I shall take issue with this statement as being but a partial truth. I need not recount the proofs as shown by the ruins of ancient Rome, but, referring simply to facts observed within our own experience, I shall declare it necessary to observe three things, none of which must be overlooked—streets, water works and sewerage. Not even in my official position am I willing to say that any one of these stands pre-eminently above the rest, for they are all needful to the development of the highest civilization, when combined with the relations of city and country, which exist the world over under so many and varying conditions that I doubt the accuracy of calling

such relations artificial. Of course, the first thing to be thought of in such different communities is to bring them and their products together, and here comes our first thought—our highways—and, as the more self-evident proposition, we find it to have been the one to which our best engineering talent first applied itself, and which shows the greater improvement. The change in the roadbed, motive power and carriages of our railway highways has been equalled by the change from earth and cobblestone to the best form of stone and asphalt pavements on our city streets. Of the third thought—sewerage. It is as yet so far in its infancy, and must undoubtedly be so varied in its application, that, with the simple statement that water has thus far proved, and probably is, the only effective carrier of sewage, we will consider the relation of sewerage to water as fully established, and pass to the consideration of water works.

"And now for the first time we find that what only a score of years ago was considered a luxury is now a necessity, and that partly from force of example, partly in order to keep up with the times, and more and above all, for our own health and convenience, it is demanded that water must be delivered under pressure in all parts of our dwellings, stores, factories and on our streets. Where a few years back only our large cities had a water supply worthy of the name, now every town and village is moving for such a supply under pressure. Already there are reported over 1000 water works in America, and Mr. Leavitt, at Montreal, last fall, stated there were 511 works in the United States and Canada that obtained their supply by pumping. The total list is daily growing. In short, if I may be allowed to express an opinion, there are no other public works in this country which begin to compare in their importance and future

prospects with water works and sewerage. Not only this, but every one of our large coast cities, from Washington to Boston, with the single exception of Baltimore, is already moving for an increased supply, and wondering where the water needed 50 years from now will come from. Chicago with Lake Michigan at its door, is confronted with the equally difficult problem of obtaining pure water.

"When we consider that the majority of these works have been constructed and the development of the wants of our large cities has only come to light within the last decade; when we further consider the capital invested and the great interests of the community involved, we can readily see that in a great number of instances these works must have been intrusted to the care of men whom capital and the community could trust, rather than to experts in water works. In fact, the growth has been so rapid that the experts have been no more than enough to supply the demand of the larger cities, and it has even been found necessary to obtain the services of the same expert for several cities. We have found, therefore, but one resource left us, namely, to associate ourselves together, to ask the representatives of the older works and the experts to meet with us, and together confess all our failures, tell of our triumphs and point out to each other how to avoid the first and gain the latter.

"Our two associations, having a common purpose, have thus met together today for the first time, and tonight the New England association and its friends bid their guests of the evening, the American Water Works association, welcome. Welcome to New England's hills and dales; welcome to its heart and centre, welcome as co-workers, as our elder brother—though the older, we will not call you parent, for we mean to be with you, shoulder to shoulder, in this struggle for knowledge, and to do our share in learning how

best to serve the community among which we may individually happen to be placed. With a membership reaching from the Golden Gate on the shores of the Pacific, to Halifax on the Atlantic, from Canada to the gulf of Mexico, you can justly lay claim to your name of "American." And may your success and usefulness as an organization be equal to your proud title, may your hours spent with us be filled both with instruction and enjoyment, and may the thoughts of New England which you shall carry away leave such bright spots in your memories that time can never efface them.

"To your president, from the Crescent city of the sunny South, we personally bid welcome, and are happy to be able to meet and present to our friends this evening Mr. L. H. Gardner of New Orleans."

Speech of President L. H. Gardner of the American Water Works Association at the dinner tendered the members of that association at Young's Hotel, April 21, 1885.

Mr. President and Gentlemen:—

I fully appreciate the honor of being the spokesman of the American Water Works Association tonight, and I value the high privilege of responding in its behalf, in grateful recognition of the princely courtesy and lavish hospitality of the New England Association. And if there be a spot on this broad American continent where rather than another a New Orleans man, on such an occasion might find enthusiasm to speed his words, that spot is Boston. If asked why, I need only remind Bostonians here present that upon the relations between Boston and New Orleans, the tears of sympathy have fallen in gracious, gentle, tender showers. The sunshine of mirth, of gladness and of good fellowship has been shed upon them. And the sunshine and the rain,

nature's great fructifiers, have brought forth out of these relations, a great golden harvest of good will. So that all the nation knows that New Orleans stretches her hand across the continent and grasps the hand of Boston and of New England in a grip of loving friendship and good will that the coming ages shall not unclasp.

I crave your pardon for this digression.

The American Water Works Association has very few juniors, sir, among the Associations of America ,but is pretensious enough to think it should take high rank among them all;—a front seat in fact in the great conclave, with the New England Association of course close upon its right. Our Association has certainly a mission of an intensely practical and unselfish character. Its *personnel* is of practical men wholly absorbed in their calling, and with a concentration of faculties and energy which I think is exceptional.

Among these members of the Association upon whom you are lavishing your kind hospitality there may possibly be those who will be touched with sympathy in seeing a tear upon the cheek of beauty. The refraction and reflection of light in drops of rain may possibly excite their appreciation of the beautiful as they look upon the rainbow;—but tear drop or rain drop, ordinarily it is all *a question of water.* Though there be grandeur or beauty in the cataract, sublimity in the heaving bosom of the ocean, or majesty in the sweep of some noble river, to them it is all a question of water—pure and simple, and its value as such or as a vehicle of power.

I stood once at Niagara, gazing in awe upon the calm majesty of the river above and the seething boiling cauldron half hid in mist below, while a glorious rainbow crowned the picture, and a solemn requiem of thunder was swelling to the heavens, a fit dirge and a fitting accompaniment to what

seemed the stately march of a grand and mighty river to its deliberate suicide.

Near me stood a venerable water works man, wrapped as I was in contemplation, and silent. Unable to refrain, to him I adventured some weak, silly and impertinent remark upon the sublimity of the scene before us. In his deafness, that deafness increased by the deafening roar of waters, with hand to ear he answered, "Yes, I was just figuring myself how much money it would all bring even at the low price of ten cents per thousand gallons, meter measurement!" Behold, sir, in this real incident an illustration of the dry practical character of this Association and of its membership, and say how I may mould speech acceptably in answering for it. As well bid me make melody out of Walt Whitman's poetry, sense out of Browning's, or such delicious wine as this from pine sawdust.

Let me rather congratulate the American Association upon the pleasant auspices which surround the opening of our Fifth Annual meeting, and upon this greeting this evening from our brother Association. Sir, and gentlemen of the New England Association, we are glad to meet you. We feel that in this meeting you in your own home surroundings, we are effecting a kind of a family reunion. We are glad to feel this embrace of our younger brother and this imprint of his kiss upon our cheek;— our younger brother! who, we think has prematurely and precociously set himself down in this corner of this great big continent, and gone to housekeeping on his own account. We have wanted to look you in the face — to take you by the hand — to see how you are getting on — to ask you confidentially if you don't sometimes feel, just a little, as though you were out in the cold as it were;— and if we so found you, to invite you into the warm heart and home of the American Association.

Oh, sir, the whole family would be perfectly delighted at such a consummation. Its members would vie with each other in enthusiastic demonstrations of affection, and if it could be made at all appropriate we would kill the fatted calf in your honor.

Antecedent to this royal reception sir, we have had taste of your quality, and had learned to appreciate you. Some of your folks come to see us every year at our family reunions, and they keep our fireside cheerful, and our wits alive, and — they keep the whole family awake o'nights!

Please pardon me sir, if my speech seem somewhat free, but I don't want to chill this meeting between us with ceremonious words. I don't think it would be appropriate. I don't think our folks of the American Association would like it. I think the family would rather I should not repel you by grave speech and stiff solemn demeanor, but rather conciliate you by affectionate words and home like behavior.

The truth is, we have a very wholesome respect for a rivalry so bold — and so successful too, as that which puts New England against all America in water works matters, and we would fain absorb it before the turrets and towers of your separate establishment entirely overshadow the old family roof tree. Say brother, won't you quit, break up, and come to live with the old folks?

Mr. President, I desire to express the warm and full appreciation of this compliment and this fraternal greeting to our Association.

If the social feature of our annual meetings be pleasant, how infinitely more so when clothed with the surroundings of this occasion.

The social feature. I almost wish I had not stumbled upon that expression, for under the inspiration of these surroundings I am borne on to say in that connection what

might perhaps as well be left unsaid in deference to the properties of a formal occasion.

But to me sir, like a skeleton to the feast, came the emphasized remark of one of our number, that the social feature of these annual gatherings is being somewhat criticised in certain quarters—outside our immediate ranks or membership. I had heard such a whisper before; but I fancy that whenever circumstances and surroundings will permit, this feature will remain to cheer and to inspire every reunion of both our Associations as long as they have name or existence;—and oh, sir, let the hand of the iconoclast be stayed! Let the land marks stand! Let some time-honored customs prevail! Let no profane hand even in the much abused name of utility, strike the feature and spirit of good fellowship from this, or yours, or any worthy Association.

Hoary history from the time of Herodotus its father honors with all the sanctions of civil and religious custom, the feast and the cup. Let who will give the philosophic reason, but these occasions make, and they cement friendships. They perpetuate and hallow pleasant associations and memories. They turn back the shadow on the dial. They pluck care and sober thought from their seat, and they open up to the sunlight the play of all our softer, better nature.

Let this feature not only be perpetuated, but let these occasions the rather be multiplied. Multiplied, even though there be found here and there miserable hide bound dyspeptics who shake their ominous heads while they talk about "junketing." Yes sir "junketing" is the word, and I fancy the word sounds very much as the man looked who invented it. Is he a myth or a man of straw to any one here? Have you not such a man in your mind's eye and is not his criticism—"junketing," lingering upon the disgusted ear of your memory?

Sir, I take leave to say that had the creation of this fair earth been entrusted to such a creature no flower would have decked her virgin bosom. No babbling song of brook or call of bird, or sigh of evening breeze would ever have waked nature's stillness to poetry and to song. No many-hued rainbow would have spanned the horizon like a banner flung from the battlements of heaven, nor any golden cloud with out-spread wings have ever guarded the western couch of a dying day.

His highest flight of fancy or of imagination—if you can attribute fancy or imagination to such a man, — would have been the deification of the lightning and the rain; the thunder and the storm. He would desire to worship their essence or some type of them as emblematic, perhaps, of active power and possible *usefulness*.

Ours, sir, is in many senses, a golden age, if it *be* one of hard work. It is an age of bright days and of bright ideas. But still it is an age in which the chief trouble is to gain the rest and recreation needed for the recuperation of brain and body tissue.

Today we live in a whirl. I will not stop to ask Guizot's question whether civilization be a good or an evil, but certain it is that in every department of life we are cultivating civilization at the expense of mental health. It is one grand rush from the rising of the sun to the going down of the same. We rush to catch trains and ferry boats; — and, having caught them, we rush to get out.

We walk, when we do walk, in a hurry, we think in a hurry, we eat in a hurry, we are taken sick in a hurry, and we die with scarcely time to say our prayers. We work better and we accomplish more, as individuals and as communities when aided by rest and recreation. And it is time that voices were raised and arms lifted—the land over,

pleading for breathing pauses from the exactions of the great American god of grind—to which we bow too willing our obedient necks—pleading for the tonic of mirth and for the occasional luxury of a good hearty laugh.

The vulgar and coarse idea of eating and drinking is not involved. Such occasions as this are pauses in the direct line of our daily duty and life work, wherein we strike hands together as if invoking a benediction upon our peculiar avocation.

Viewed in this light, they are unwritten poems whose cadence will linger upon the ear amid the sober cares of all after daily life. Pictures they are, which we will hang up on memory's walls in choice and sunny places. Oases;— decked with palms as green as those of Elim, and refreshing as her wells. Will we not, all of us, count them as delightful reminiscences, and grow garrulous over them in the evening of life? Let us cherish them as pearls strung upon the net work of what at best is to each of us a prosy life, and until "the fever called living be ended at last," let us reckon these moments we thus spend together as among its most grateful pauses.

Mr. President, may unabated success and large usefulness attend the history of the New England Water Works Association.

May peace, prosperity, and undimmed glory be perpetuated to New England, its home;— and may her coming generations never fall below the high standard which now makes her great in all that makes a people noble.

[At the conclusion of President Gardner's address, the orchestra playing "Dixie," the applause was fairly deafening, culminating by the audience rising *en masse* and giving three enthusiastic cheers for President Gardner and the American Association.]

President Ellis then said: "The people of western Massachusetts have a just pride in the gentleman at present occupying the executive chair of the old Bay state. They have known him at home as a neighbor, and at the bar. They have watched with approval his course in Congress, and have twice been made more proud by finding their own good opinion indorsed by the entire commonwealth. They know his interest in manufactures, commerce and agriculture, and of what is of more importance to us, his watchfulness over the health of our people. Let me add to you, waterworks superintendents, we know him as a man who has practical belief in water, thinking that it is as good to drink as to sell. Gentlemen, Gov. Geo. D. Robinson of Massachusetts.

SPEECH OF GOV. GEORGE D. ROBINSON.

His excellency, upon rising in answer to the introduction of President Ellis, was greeted with great applause. When it became quiet he said:

Mr. President and Gentlemen:— "When one takes a glass of water on his own account, it delights him first of all to find others of like mind. I am pleased to see so many of you take to the natural drink and slight the artificial ones. (Laughter.)

When I came here this evening, one of the gentlemen whom I met, in conversation said to me:

"I suppose you know most of the gentlemen present."

I replied that I scarcely knew any of them. The gentleman appeared to be very much surprised at my answer, and said in a tone of voice which indicated great astonishment,

"Why, I thought a man in politics, like you, knew everybody!"

My reply to this was "Politics do not always run by water." (Laughter and continued applause.) Speaking of water carries me back in memory to my childhood days and "The Old Oaken Bucket That Hangs in the Well." And here in Boston it might bring to mind some of the old scenes when the worthies went down into Spring Lane to get a supply of cold spring water, pure and fresh, to take to their homes. In speaking of water works, one is apt to think that all the developments are now and here, and that the people of by-gone centuries had no knowledge of supplying all people with that necessity of life. But we know that the ancients were skilled engineers to a surprising degree, and that their great works far surpassed ours of the present time, considering the means at our disposal. The great secret of a perfect water supply lies in bringing it home to the people; in turning the rivers into every man's dwelling and giving him an opportunity to tap life's fountain. That is what you gentlemen should seek for—it is not to furnish a great work that shall astonish the eye, but to bring to every man's dwelling the purest supply of water at the cheapest rate. [Applause.]

In talking about the dry subject of water a man has to look it up, you know, so that he can make a successful extempore speech. [Laughter.] In looking over the Legislative acts of this state, dating for years back, I was struck with this—that, down to 1885, all the acts passed by the Legislature governing and restricting the use of water, can be included in the number 10, in 215 years. Very little did this subject of water and water supply attract the attention of the people in the early days. In the scattered villages and towns there was no occasion to do so, and consequently that important matter was slighted. The subject of water seems to have occupied a great deal of the time and attention of the

General Court between the years 1845 and 1865, for I find during that time that a great many acts were placed upon the statute books. In the twenty years following 1865, or up to the present time, the State of Massachusetts has had in the neighborhood of 425 acts relating to its water supply. In 1884, the Legislature passed 66 acts in reference to that one subject, while the present Legislature, to date, is left far in the distance in comparison, for it has only made nine. [Applause.] There is one feature which strikes me as peculiar in our legislation on this subject. The acts read: "To supply the town of —— with fresh water." That is what the people of Massachusetts asked for in the early days. Now the women always manage in some way to get mixed up in anything of importance in which the men are interested. They became mixed up in this, and, having their washing in mind perhaps, had the word "fresh" stricken out and "soft" put in. Next "pure" water came. Then that gave out, and now the acts read simply "To supply with water." So you see that all a man gets now is water. Gentlemen, that is a very suggestive thought. [Laughter.] What are we getting to drink here in Boston? Is it fresh, soft, pure or simply water? That is Boston's drink the whole year round, gentlemen. (Loud laughter and applause.) What is the city of Springfield taking in month after month from the sewer's mouth? Anything but water. Anything but cleanliness. Is there not something for the American Water Works Association and the New England Water Works Association to do?

Closely connected with this subject is one of great commercial importance — that of sewerage. That brings a critical problem for each to investigate. The great danger of water-supply pollution should make every member of the American Water Works Association alive to the subject.

It is a question of great importance and also a practical one which your convention will settle. (Laughter.) Here are the great water men of the country assembled and resolved into their original element, (more laughter), and they should tell a listening country what relief it is to expect.

It will be the Mayor's opportunity and his pleasure, I am sure, to give you all a hearty welcome to Boston. I represent a larger constituency and a larger territory. I bid you welcome to New England; to the old Bay State. I welcome you to her cities, her hills, her valleys, her hearts and her homes. (Great applause.) There is a welcome not only for the very eloquent and poetic friend from New Orleans, Mr. Gardner, your president, but for all the friends who stand loyal to the flag of the country as never before. [Applause.] There is no better illustration of this than in the very water you talk about. It is here today and in the clouds tomorrow, ready to fall in the neighboring states, symbolizing the intimate union and unfaltering loyalty among all our people in this blessed country — heart with heart, reaching with fraternal affection over the bounds of states. Gentlemen, we are glad to see you. Massachusetts greets you all." [Loud and continuous applause and cheers.]

President Ellis. Geologists tell us that ever since the earth took form, and from the void sprang into being, that constant change has been going on within, from its centre to circumference. The astronomer, pointing his telescope to the starry heavens, tells us that the sun, the centre around which our world, the planets, and all their attendant satellites appear to be revolving, is itself moving in space at a rate which will in some six millions of years (a few more or less) bring it again to the position it now occupies. As

we thus look around us and observe that all nature, both terrestrial and celestial, is constantly changing, the average water works man may well exclaim, "Is there anything fixed and certain?" To such I reply, there surely is. If you will turn to next to last page of our souvenir menu, you will find an illustration of what I mean, — the city of Boston, the centre fixed and stable, about which revolves New England, and I might almost say the world.

Gentlemen, His Honor Mayor O'Brien of Boston.

SPEECH OF MAYOR HUGH O'BRIEN.

Mr. President and Gentlemen of the American Water Works Association: —

The city of Boston feels highly honored by the presence of so many distinguished engineers and others connected with the water supply of all the leading cities of the country. The speakers who have preceded me have remarked that the question of water supply is a very important one, and would be for many years to come. I fully appreciate that fact. I think that the Governor must have rehearsed his speech to the members of the Association as to what kind of water we drink in Boston. As a distinguished member of your Association from Brooklyn has remarked to me at the table, there is no waste of water here to-night. [Laughter.] These colored glasses must have been filled with something besides Mystic or Cochituate. [Further laughter.]

The city of Boston extends a cordial welcome to the gentlemen of the American Water Works Association. For some forty years we have been largely interested in the question of water supply. During that time we have expended over $20,000,000 to secure plenty of water and as pure as possible. There is still considerable work to be done so far as improvements are concerned During the last ten

years we have expended at least $10,000,000 for a water supply, and I expect that during the next ten years as many more dollars will be judiciously expended in increasing our present supply. It is the best investment that Boston has ever made. It has increased our prosperity and growth. It has built up our manufacturing and industrial pursuits, and its extension has proved a profitable investment. There has been no time during the past forty years when the supply of water in this city has been equal to the demand. We have expended large sums of money for sewerage as well as water. It is well known that the water supply and the sewers must go together. During the past ten years we have expended about $6,000,000 for improved sewerage, and large sums of money for the remodeling and building of new sewers. I believe that our present system is as perfect as it can be made. You, gentlemen, need not be afraid of introducing pure water in any city you are connected with, no matter what the cost may be. It will add to its prosperity and will promote its industries, while the blessing of pure water to the community alone is one of the greatest.

I thank you, Mr. President, for the kind words you have spoken of Boston. This city expends large amounts of money for improvements for cleanliness, and I feel that what you say is correct. If you were to watch the doings which relate to Boston transacted on Beacon Hill, you would become impressed with the idea that Boston is the most corrupt city in the country. But Boston to-day is the only city in the Commonwealth that can reduce its limit of indebtedness, for it has made a reduction from 3 per cent. to 2 1-2 per cent. in a year, and can reduce it from 2 1-2 per cent. to 2 per cent. in two years. We have also put a limit on our taxation which any city in the Commonwealth can stand. When the members of the Legislature talked about lim-

iting the taxation of the cities of the Commonwealth, that fact came out quite prominently. We have made improvements and have incurred expenditures of over $20,000,000 for sewers, parks and other improvements in ten years, and yet the indebtedness of the city is less to-day than it was ten years ago, notwithstanding these many great improvements. I think it is a creditable showing. We are increasing in population from year to year, increasing in wealth, and our public improvements now in progress will make Boston the finest city in the country. I have been introduced to so many mayors and ex-mayors in this company that I feel I am talking to men who know something about municipal affairs. I will conclude by thanking you for your kind attention. [Cheers and applause.]

President ELLIS. Among those present with us this evening, representing the American Water Works Association, is the Water Purveyor of the third city in size in this country, whom I now have the pleasure of introducing to you, the Hon. Peter Milne, jr., of Brooklyn, N. Y.

SPEECH OF HON. PETER MILNE, JR.

Mr. President and Gentlemen: —

I think that a little of carbonic acid is desirable for the stomach's sake. Water works men need not less oxygen and not more nitrogen. (Laughter.) I scarcely know what to say upon an occasion of this character. Great honor is conferred upon both associations by the presence of the Governor of the State, the Mayor of Boston and other distinguished men of the Commonwealth. The fact that they honor us with their presence, and the expressions of appreciation of the character and work of the associations, should be a source of enjoyment to us. I believe the secret of the power of

these associations lies in the conservation of its forces. Reason and inference will develop intelligence. It is an evidence of progress when men meet in associations having one object in view, and compare thoughts and experiences. Man knows but little if he does not mingle with men of like thought and mind. It would seem proper for water works men to make such deductions from their experiences as may result in mutual benefit to themselves and the interests they represent.

I trust the sentiments expressed may prove the source of an inspiration that will bring together a larger assembly and develop greater improvement in its work at the next year's convention. Enough has been said by me. I thank you, gentlemen, for your consideration. (Warm applause.)

President ELLIS. If there is anything which a water works man insists upon, it is fair play, and that both sides shall be heard. Somewhat has been said here to-night derogatory of Boston's water supply; we should be glad to hear the other side and to listen to the Hon. W. A. Simmons, chairman of the Boston Water Board.

REMARKS OF HON. WILLIAM A. SIMMONS.

Mr. President and Gentlemen of the American Water Works Association:—

I have listened with a good degree of pleasure to the remarks of both the Mayor of the city and His Excellency the Governor of the Commonwealth, and I may very properly say what the modesty of the Mayor has left unsaid, that the city of Boston is largely indebted to the zeal and energy which he has constantly manifested in the aldermanic service for the present admirable condition of the water interests of the city.

The Governor has referred to the marked increase in the number of the water bills before the Legislature during the past few years, and naturally infers that the question is a growing one with the people of the State. He might have added that the underlying reasons for this unusual tax upon the legislative body are the tendencies of the people in all the larger communities to reach out after the same privileges as to water conveniences that are obtained in the great cities of the country.

The growing tendency in all well-to-do communities is to secure the best modern appliances for lighting households and places of business, and the best possible supply of pure water for domestic and business purposes. It is because of these facts that the Legislature is crowded with petitions, and the work of the committee having this question in charge is largely increased.

In proportion as the different communities reach out for permanent supplies of pure water do the natural sources become invaded and taken up, until latterly, contests have arisen between remote communities desiring pure water for their people and the towns near the sources of supply which claim the right to empty their sewage into them as a natural right. This condition of affairs brings us face to face with two very important questions,—questions which you as a body should impress upon His Excellency the Governor, the importance of which both he and the Legislature should fully understand and appreciate. Of these questions the first is the necessity of some general legislation which shall protect the purity of the water supplies of the various communities in the State, and the second is the imperative and paramount necessity of establishing a system of sewerage in every community adopting a water supply.

These are questions of vital importance to all the citizens of the State, and the State itself, as the natural sanitary guardian of the people, should adopt some general plan of metropolitan sewerage under the operation of which local sewage may be carried to some common place of deposit, as is the case under our Boston system, where the outlet is at Moon Island to the ocean. Boston has been foremost in obtaining the necessary legislation to protect the purity of its water supply, and was one of the strongest advocates for the appointment of a commission to consider a metropolitan system of sewerage. If the Legislature of this year should enact any laws looking to the strengthening of these sanitary measures for the public benefit, I sincerely trust His Excellency the Governor will at once approve them.

One of the great benefits to be derived from such associations as are gathered here to-night, is the education of public men up to the appreciation of the importance of these sanitary questions; to impress upon them the necessity of guarding the health of the people by the enactment of stringent laws with reference to pure and abundant supplies of water, and a proper disposition of the sewage. You are the educators, the moulders of public opinion in these matters, and you should take early and constant occasion to place the results of your labors and experience before the people of your respective communities. It is a part of your duty to endeavor to check the enormous and most prodigal waste of water that is constantly going on. Boston has reduced her consumption ten millions of gallons per day by a system of house to house inspection. This is a saving at both ends. It saves in expense of pumping the water originally, and lessens the quantity of sewage to be pumped. Besides this, it is a postponement of the buying of new sources of supply at enormous expenditure of money. You can do no greater present good

than to present to the prodigal communities who use their supply so lavishly, the necessity of the exercise of a reasonable spirit of economy.

I congratulate you upon the good your associations have done, and upon the much larger good they may have the privilege of doing, and I particularly rejoice that our friend from New Orleans is privileged to be among us to reflect upon us the genial and generous spirit of his own sunny land; to stand here upon Massachusetts ground, almost within the shadow of Bunker Hill and Faneuil Hall, and give utterance to sentiments of patriotism which find full communion in every heart, causing us one and all to feel that the same spirit which united Massachusetts and New Orleans in 1812 dwells with us in brotherly accord here to-night; and that once more the South and the North, the East and the West, sit beneath the same vine and fig tree, and liberty finds its common defenders in the blue and the gray, under the stars and stripes of a reunited and prosperous nation. (Cheers and loud applause.)

President Ellis. His Excellency has suggested that the present Legislature has passed less bills affecting water works than that of a year ago. Without wishing to ask impertinent questions, as long as we are all water works men, possibly we may gain a little light by calling on the Hon. J. Q. A. Brackett, Speaker of the Massachusetts House of Representatives.

SPEECH OF HON. J. Q. A. BRACKETT.

Mr. President and Gentlemen:—

I am greatly obliged to you for the privilege of being present at this festival, and of meeting so large a representation of those who are interested in the subject of water and water works. Associations like yours constitute one of the monuments which mark the progress of the country and the new demands of civilization. Many of us here present remember the time when there were no water supplies such as now exist in our cities and large towns, and when the water for domestic purposes was obtained from wells and springs, and the only water works were the old-fashioned well sweep and the old oaken bucket immortalized by the poet Wordsworth. No draughts of modern times are sweeter than those thus procured in the olden time. But with the growth of our towns and cities these primitive methods of supply became inadequate, and new and ample ones had to be devised. The interest which you represent is one to which the Legislature devotes much of its time. At every session a great number of applications are received for legislation authorizing the waters of certain streams and ponds to be taken for the purpose of supplying the people of various localities with pure water. Four of the great necessities of life are pure religion, pure politics, pure food, and pure water. [Laughter and applause.] As a member of the Legislature, modesty forbids my relating how much that body annually does in behalf of the first two of these necessities; but it may be excusable on an occasion like this, where it seems appropriate to briefly advert to what it does for the last two. By the various acts which have been passed for the prevention of adulteration, the Legislature has done what it can to secure pure food for the people, and, as defects in existing

laws having this end in view become apparent, it is always prompt to remedy them. By its liberality in responding to the applications for water supplies, it has contributed all in its power toward providing the people with pure water. We have two joint committees to deal with matters affecting the beverages in common use, namely, the committee on liquor law and that on water supply. [Laughter.] These committees, however, have opposite functions and purposes; the province of the first being to consider legislation for limiting the use of that which gives the committee its name, while that of the latter is to facilitate the supply and use of water. In a debate in the House last winter, a member made an effective point by making a comparison between these two subjects of legislation. The pending bill was in relation to a water supply for the town of Watertown, and the question under discussion was whether the act should take effect upon its acceptance by a majority only, or by two-thirds of the voters of the town present and voting. Favoring the majority side and referring to the local option law, the member said: "Mr. Speaker,—Every town in the State can have all the rum it wants by a majority vote, and I think it ought to have all the water it wants by a majority vote." The majority side prevailed. [Laughter.] The related subjects of water supply and of drainage form one of the most difficult problems by which we are confronted. The available sources of supply within the State are being rapidly appropriated, and at no distant day they will be entirely taken. Cities and villages are growing upon the banks of our streams, from which many of them obtain their water and which at the same time receive their drainage. Take the Merrimac river for instance. Upon its banks are the cities of Concord, Manchester, Nashua, Lowell, Lawrence and Haverhill, and many towns. A portion of these cities take their water from

the river, and all of them pour their sewage into it. The water of the city below is thereby polluted by the drainage of the city above. How to deal with the evils resulting from these conflicting uses of the same river is a very serious problem. It is one which will grow more complicated and difficult as time passes on and population increases. It is one to the solution of which associations like yours, both collectively and through their members individually, can largely contribute, and to you we must look for this service.

It is just forty years ago that the act was passed authorizing the introduction into Boston of water from Long Pond, now called Lake Cochituate, in Natick. In October, 1848, a vast concourse of people assembled on the Common to celebrate the formal completion of the work, and the Mayor, asking if it was the pleasure of the assemblage that water should then be introduced, and being answered by a tremendous shout in the affirmative, opened the gates, and a column of water six inches in diameter arose eighty feet in the air The bells were rung, cannon discharged, and the air resounded with the acclamations of the assembled thousands. This was one of the first, if not the first, enterprise of the kind in this section of the country. It is not easy to realize the large and rapid growth in the number and magnitude of systems of water works since that time. This large gathering, however, is a reminder of that growth. The fact that so large and successful a meeting is held is an evidence of the numerical strength and the prosperity of your profession. Upon that prosperity I tender you my hearty congratulations, and thank you again for the opportunity of being present on an occasion of so much interest as this. (Long continued applause.)

President ELLIS:

In a very large proportion of our Water Works, about one half of the total number, I believe, it is necessary to obtain a supply by pumping. Under such conditions, the ability and skill of the mechanical engineer is called to our assistance to devise and arrange the complicated machinery therefor. Among the members of the American Association whom I see here tonight, is Mr. W. B. Sherman, secretary of the celebrated Corliss Steam Works, of Providence, Rhode Island.

REMARKS OF W. B. SHERMAN.

Mr. President: —

Though joining the Association in its early days of organization, the present is the first time that I have had the pleasure of attending one of its meetings. When I learned that the American Association had voted to hold its annual convention of 1885 at Boston, I doubted much its success, considering the selection of a point so far east, so remote for the majority, almost in the light of a bold challenge to its members to testify by their presence the interest and faith they had in the good work the organization had done and with proper cooperation may continue to do.

How well that challenge (if it may be so termed) has been met we all know from the results of this the first day's attendance and interest—and right here I wish to give a word of advice to President Gardner; and the others, especially New England members, will please not listen.

(To President Gardner,— That from the grand outlook of success which this convention portends you have only to bring the American Association to Boston once more to absorb all New England to your fold.) It must be a source of great gratification to that small body of men who assem-

bled in St. Louis four years ago, to note the growing strength and influence of the organization which they at that time brought into existence. From the original roll of 10 members at St. Louis the American Association has reached in its four years of life a membership of 174, at the present time. The subject of water works is not a new one; for ages man has been carrying on to successful end great schemes of this character, and I know of no vocation in which mankind is engaged that so thoroughly and completely satisfies his intellectual desires as that covering all the problems of water supply from storage to distribution.

This is the age of associations — a banding together of men interested and working in the same profession or calling. Years ago such an assemblage as we have here tonight would have been impossible; but the present advanced state of railroad communication permits us to enjoy at this festive board, the hearty communication and exchange of good fellowship with our friends from the South, West, North, and East, who have come thousands of miles to see us and note what we are doing.

The acquaintanceships brought about at such occasions, circulates a fund of information, an interchange of ideas in which all are interested and which can be had in no other way, so clearly or understandingly.

All knowledge any one possesses comes from what he reads, observes or hears from the lips of others. Printed matter on the subject of water works practically considered is comparatively meagre and oftentimes written by impractical men and such information must be absorbed with certain grains of allowance. At these gatherings, meetings of practical men, actively engaged in the construction and maintenance of water works, we learn what each is doing either in way of experiment or actual work and the results

of such experiences are often of great pecuniary value in deciding questions for the corporations which we represent.

President ELLIS:—Our lawmakers have been well represented, but we should still be glad to hear from the Chairman of the Senate Committee on Water Supply, Senator Wells of the Mass. Senate.

REMARKS OF SENATOR HENRY J. WELLS.

Mr. President and Gentlemen:—

For many years I have been interested, in connection with my practice as an attorney, in questions relating to water supply, and, more recently, as a member of the Legislature during several sessions, I have devoted much time to the investigation of matters relating to water supply and drainage. In addition I have employed my time in trying to introduce uniformity in the bills reported by the committee on water supply, and, during the sessions of the Legislatures of 1883 and 1885, it fell to my lot to draft most of the bills relating to this subject. I am pleased to learn, to-night, that, while working in different spheres, the members of your associations and myself have been striving to advance the same good cause. It is a stimulus to renewed efforts, as well as a great satisfaction after the many hours of labor I have given to this subject, to find so many others interested in this same matter. As has been intimated by His Excellency the Governor, in his remarks, the subject of water supply is, year by year, increasing in importance and magnitude. Measured by the imperative need of pure water for domestic purposes; by the conflict of interests involved in taking water from one community and giving it to another; by the questions of the highest use of water for domestic purposes against its use as a power or for manufacturing purposes; by questions of drain-

age, which are inseparably connected with a water supply; by the pollution of available sources of water supply, which have not yet been appropriated, but which are likely to be destroyed unless some remedy is adopted to save them for the time when they will be needed—all these, and others which will readily suggest themselves, point to the necessity of a state board of water commissioners, who shall take this whole subject of water supply in charge, investigate the needs of the several cities and towns, the available sources of supply and the dangers from pollution which threaten them, and then adopt such measures as will best apportion our limited water supply to meet the wants of the several cities and towns. Already the amount invested in our water supply is enormous in the aggregate. And yet it will be still larger, for time has shown that when water is once introduced into a city or town the demand for an increased supply keeps pace very naturally with the growth of the community using it, and our population is increasing every year. How are these demands to be met? Where is our supply of water for the future to be found? These are questions which require our earnest study and consideration in order that we may answer them wisely. The attendance upon your convention, the deep interest which has been manifested in your deliberations and discussions indicate that you are already fully alive to the great importance of these vital matters. I trust that you will ever remain so, and give your best efforts toward solving such problems relating to water supply as may come before you. (Applause.)

PRESIDENT ELLIS: Gentlemen, among those who have contributed to our pleasure this evening, I am happy to be able to present Mr. Desmond Fitzgerald, Superintendent of the Western Division of the Boston Water Works.

REMARKS OF DESMOND FITZGERALD, C. E.

Mr. President and Gentlemen:—

When I received an intimation that something of a watery nature might be expected from me to-night, I must confess the sensation was not exhilarating. When a man has already performed the very pleasant duty, as I did this morning, of sending in the 27 millions of gallons of water for the daily consumption of the city, and then of adding to this quantity some 2 or 3 millions more for your consumption this evening, it passes my comprehension why he should not be allowed to sit in peace; but perhaps it is because you have so little appreciated this portion of my work (for by the most liberal estimate there does not seem to have been more than one gallon consumed here to-night), that I am called to go a step further. Now, sir, I could not help feeling how much easier it would be to say something interesting if I belonged to any other than a water fraternity. For instance, if we were all wine merchants here to-night, what a wealth of sparkling humor there would be brimming over at our disposal! What merry pictures connected with the juice of the grape would dawn before our eyes! But as matters are, I suppose we must come down to this dry subject of water; and those of us who are familiar with this much berated fluid will acknowledge that there is a great deal in it. If these specimens that I hold in my hand really came out of the Boston water, as is claimed, why then there is some life left even in Cochituate. But seriously, Mr. Chairman, it is my firm belief that we water men belong to the best and most progressive of all occupations. Only a few years ago public works for the supply of water were confined to a few of the larger cities of the country. Now there are more than 1000 public water supplies in the United States, absorbing in their construction

an amount of capital which seems almost fabulous. The cost of our own works in this city has already reached the enormous sum of nearly 20 millions of dollars, and we do not claim to have more than enough water for our present wants in a series of dry years, although with slight extensions the present scheme of works will supply about a million of people. In the neighboring city of Providence, the second largest city in New England, not a single drop of water was delivered from a public supply until about fifteen years ago, and at that time, if my memory serves me right, there were some 50,000 people in her municipal limits. At the present time this flourishing city has one of the finest and most scientifically organized supplies in the country. New York, with her teeming masses of humanity, has been dependent upon a single aqueduct for about half a century, and she is now pushing to a speedy completion one of the largest, if not the very largest, systems in the world, involving the building of the highest dam that the hand of man has ever undertaken, and an aqueduct fourteen feet in diameter, to carry 300 millions of gallons per day to her thirsty people. When the original works for the supply of Boston were undertaken, in 1846, people very generally laughed at the engineer for providing such a great system. They said the city never would be large enough to use all the water that such an aqueduct would bring down, and yet in less than ten years the consumption of the city had increased to such an alarming extent that notices had to be issued calling the attention of citizens to the fact that if the rate increased, the city would be unable to supply the demand. When the massive structure known as the Beacon Hill Reservoir was completed, the orators of that day compared the solidity of construction to the works of the ancients, and prophesied that centuries would look down upon its enduring form.

Yet this reservoir has recently been entirely demolished, after a short existence of less than forty years. In 1872, the Sudbury aqueduct was projected, with a capacity of five times that of the Cochituate, and with the great system of works known as the Sudbury river system we are comparatively safe. But I must not weary you longer on this topic. I have tried to indicate briefly, by a few familiar examples, the rapid progress which we are making here in this country in this vital matter of water supply. Let no man suppose that there is not, in the building or management of water works, every scope for the most brilliant talents and the most unremitting toil. (Applause.)

President Ellis. We have with us this evening a gentleman representing our smallest New England State, and at the same time one of the best water works of the United States. I refer to those of Pawtucket, Rhode Island, and call for Col. Olney Arnold of the Pawtucket Water Board.

REMARKS OF COL. OLNEY ARNOLD OF PAWTUCKET.

Mr. President and Gentlemen of the New England Water Works Association:—

For your invitation to be present on this occasion, I give you my heartfelt thanks. I can endure much in a good cause like this. Good eating is a favorite pastime with me, and I can stand an infinite quantity of such talking as you have had here to-night, but it requires a brave man to stand up in the presence of so many men distinguished for their eloquence and culture, and attempt to make a speech. I would like to say a word in excuse for rising at all. In a conversation with Superintendent Darling, yesterday, it was agreed that Col. Wyman should speak for Pawtucket, and you have so entered on your programme. Unfortunately the Colonel was obliged

to leave at 10 o'clock, before the Governor had concluded his remarks. Having been called upon a few times by my neighbors, on similar occasions, I became unable to enjoy my dinner, for fear that I might be called on, without preparation, to assist in the post-prandial exercises. To avoid this anxiety, I finally adopted a plan that has proved successful at home, and I am under the necessity of trying it on here. My plan is this: With the aid of a machine, which I keep expressly for the purpose, I grind out a few lines, taking care to have the words jingle as much as possible; then, after enjoying my dinner, if I am called upon, I read my lines and am never annoyed afterwards. This afternoon, fearing that my friend Wyman might not come, I sat down, without the machine, and commenced the jingling process. Upon his arrival, thinking that I should not need the lines, I put them in my pocket. With your permission I will read them.

PROLOGUE.

A *Darling* Super, of renown,
Residing in the largest town
Of this grand land of freedom;
Said to me but yesterday,
"Will you, at Tuesday's banquet, say
A few words, if we need them?"

I, Yankee like, made this reply:
"We there shall meet men ranking high
In eloquence and knowledge;
Men who to lofty heights can soar;
Men who are skilled in all the lore
And culture of the college.

"Then how, my friend, can you or I,
Who scarcely dare at home to try
Our voices in town meeting;
Expect at such a place as Young's
That we can speak with glowing tongues,
And get a pleasant greeting?"

If I am called upon, I'll say
That I am not prepared to-day,
I'll call on you or *Lyman;*
Then you can make some good excuse,
And manage then to introduce
That prince of talkers—*Wyman.*

As Burns has said, I'll say again,
"The best laid schemes o' mice an' men,
Gang aft a-gley" and come to naught;
Say to Wyman, you that know him,
That the reading of this poem
Is known to be his fault.

THE ADDRESS.

I thank you, Mr. President,
And Secretary Glover;
For your kind invitation sent
To me to join in this event;
I've lived three hours in clover.

The Governor of this great State,
The Mayors of its cities;
And all who here participate,
However humble, grand or great,
Have shown us what true wit is.

The "Americans" this morning came
To attend their convocation;
To-night they dine with you on game,
And with wit sparkling as champagne,
They speak in commendation—

Of all you've done, of the expense
Attending such good eating,
Of the speeches, rich in eloquence,
And full of good, strong, common sense;
It's been a glorious meeting.

But Water is our theme to-night,
Soft water from the river;
Water,—cool, sparkling, pure and bright;
Water, that gives us such delight;
All praise to Him, the giver.

The old moss-covered bucket's gone,
How fondly memory lingers
Where in my youth, at early dawn,
I took a drink from it each morn,
And bathed my face and fingers.

Then, water from the pond or rill,
Lake, stream, or water-fall;
Might turn the wheels of the old mill,
Or wash our clothes, but not a gill
Was used for drink at all.

But now as drops the falling rain
From clouds in upper air;
Washing the flowers, grass and grain,
We gather it in store again,
And drink it everywhere.

No drink is half so sweet as this
From glass or oaken bucket;
Sweet is the maiden's dewy kiss,
But as for drink, the nectar is
The Water of Pawtucket.

I've noticed one thing here to-night,
No water has been wasted;
The drinking has been very light,
Cochituate is kept so tight,
It scarcely has been tasted.

There's only one thing here I miss,
I'll speak it without leave;
Without sweetheart or wife to kiss,
How can a man have perfect bliss?
There's no Eden without Eve.

We hope to see you all some day
In the City of Pawtucket;
We'll sail you down our lovely bay,
And give you clams cooked every way,
And water from the bucket.

Our present Governor, A. O. B.,
Will give you welcome true;
I hope you'll come next month to see
Us inaugurate Lieutenant D.
And Governor W.

And now I bid you all good night,
The hour is getting late;
You've given us such great delight,
I hope your guests will you requite,
And I participate.

Other speakers were Prof. Vose, President of the Boston Society of Civil Engineers; Col. Albert A. Haggett, President of the Lowell Water Board; and Edward W. Cate, President of the Newton Water Board.

The Secretary exceedingly regrets that circumstances beyond his control prevent their remarks from becoming a part of this record.

At the conclusion of Mr. Cate's address, President Ellis pronounced the "benediction," and at half-past twelve o'clock the banquet came to an end.

WEDNESDAY, THURSDAY AND FRIDAY.

The programme arranged for these days was carried out successfully; being favored with delightful weather, the meetings and various excursions were largely attended, and the interest and enjoyment of all were thereby increased. Lack of space prevents a description in detail of the excursions, and a report of the papers read and discussions had in the Convention is rendered unnecessary from the report already made by Secretary Decker of the American Association; a few statistical pages, prepared for use during the excursions, are, however, appended hereto, as an interesting souvenir, and also the names of the committee of arrangements to whose energy and enthusiastic application the great success of the Convention may be chiefly attributed.

ALBERT S. GLOVER,
Secretary.

STATISTICS

RELATING TO PUBLIC WORKS VISITED BY THE ASSOCIATION.

INSTITUTIONS UPON DEER ISLAND.

House of Industry	Average number of inmates, 773
Truant School	" " " 149
House of Reformation	Girls, 13
" "	Boys, 75

BOSTON MAIN DRAINAGE — STATISTICS.

Length of main and intercepting sewers to pumping station	131-2 miles
Diameter of main sewer	7½ to 10½ feet
Inclination of main sewer	1 in 2,500
Ordinary daily amount of sewage pumped	25,000,000 gallons
Average lift	35 feet
Average daily amount of solids removed by screens at filth hoist	1-2 cubic yard

HIGH DUTY PUMPING ENGINES.

Designed by	E. D. Leavitt, Jr.
Built by	Quintard Iron Works
Cost about	$115,000 each

LEADING DIMENSIONS.

Diameter of high pressure cylinder	25 1-2 inches
Diameter of low pressure cylinder	52 inches
Diameter of plunger	48 inches
Length of stroke	9 feet
Distance between centres of cylinders	15 feet 2 inches
Radius of beam to end centres	8 feet 3 inches
Radius of crank	4 feet
Diameter of fly-wheel	36 feet
Weight of fly-wheel	36 tons
Nominal capacity	25,000,000 gallons a day
Speed for capacity	11 strokes per minute
Duty developed on 24 hour trial	125,000,000
Duty of boiler, 12 pounds of water evaporated by	1 pound of coal

LOW DUTY PUMPING ENGINES.

Built by the firm of Henry R. Worthington, of New York, from their own designs.

Cost	$45,000 each
Nominal capacity	25,000,000 gallons a day
Speed for capacity	12 double strokes per minute
Diameter of high pressure cylinder	21 inches
Diameter of expansion cylinder	36 inches
Diameter of plunger	45 inches
Length of stroke	4 feet
Guaranteed duty	60,000,000

DEPOSIT SEWERS.

Length of double sewer	1,260 feet
Size of each sewer inside	8 feet wide and 16 feet high
Average velocity through deposit sewer	3 inches per second

DORCHESTER BAY TUNNEL.

Total length	7,160 feet
Inside diameter of brickwork	7½ feet
Thickness of brick lining	12 inches
Depth below low water	143 feet
Ordinary velocity in tunnel	1 foot per second
Velocity with four pumps running	4 feet per second

OUTFALL SEWER FROM SQUANTUM TO MOON ISLAND.

Brick sewer	11 feet high and 12 feet wide inside
Wooden flume	6 feet x 6 feet inside
Distance from Squantum to Reservoir	about 6,000 feet

MOON ISLAND RESERVOIR.

Area	5 acres
Height of floor	1 foot below high water
Height of walls	16 feet

Discharge takes place about one hour after each high tide.

Time occupied by discharge	40 minutes

MYSTIC WORKS.

Statistics.

Supplies Charlestown, Somerville, Chelsea, and Everett.

Total population	88,000
Daily average consumption in 1884	6,209,700 gallons
Reservoir	147 feet above high water
Capacity of reservoir	26,200,000 gallons

Pumping machinery: Three Worthington compound duplex engines, two 5,000,000 gallons each, and one 8,000,000 gallons per 24 hours.

At the pumping station there are three horizontal return tubular boilers, built in 1884.

Boilers, each 78″ diameter, 17′ long, shell 7-16 inch steel, containing 151 3″ tubes.

Grate surface . . . . . 42 square feet

A twenty-four hour test of these boilers gave the following results:—

Water evaporated per lb. of fuel at observed temperature and pressure . . . . . 9.8 lbs

Equivalent evaporation from and at 212 degrees . . 11.035 lbs

Water evaporated per lb. of combustible from and at 212 degrees 11.931 lbs

Fuel burnt per hour per square foot of grate . . 9.52 lbs

CAMBRIDGE WATER WORKS.

Statistics.

Total population 62,500

Source of supply; Fresh Pond.

Source of additional supply Stony Brook.

Area of Fresh Pond . . . . . 180 acres

Area of Fresh Pond water shed . . . . 1,200 acres

Daily yield from unseen sources . . . 1,700,000 gallons

Additional supply from Stony Brook is now being put in. It will require 8¼ miles of 30″ and 36″ pipe.

The water is pumped through the mains to the reservoir, making the reservoir a storage and regulating basin.

Two compound duplex condensing Worthington pumps capable of pumping 5,000,000 gallons per day.

One compound duplex condensing Worthington pump capable of pumping 1,000,000 gallons per day used for high service pumping to stand pipe.

Length of main 88¼ miles of cast iron pipe.
" " " 6¾ " " cement lined.
Total " " " 95 " " laid.

Number of services 8,000

Number of hydrants 600

Average daily consumption low service . . 2,486,000 gallons
" " " high service . . 200,000 "
Total average daily consumption . . . 2,686,000 gallons

Cost of construction $1,750,900.00

Net water debt $672,338.44

Estimated receipts for 1885 . . . . . $190,000.00

NEWTON WATER WORKS.

Statistics.

Area of city . . . . . 11,600 acres
Population 20,000
Source of supply: Filter Basin on the banks of Charles River, which is fed by intercepted springs.
Length of basin . . . . . 1,575 feet
Width " " . . . . . 70 to 80 feet
Bottom at grade 81, or about 10 feet below ordinary level of river.
Low water grade 85
High " " 93
A 24″ conduit, 606 feet long, leads to pump well.
Boiler: 3 tubular, 5′ 3″ diameter, 19′ 8″ long, containing 54 tubes, 4″ diameter and 19′ 8″ long, built by Kendall & Roberts.
Heating surface . . . . . about 1,500 square feet
Grate surface . . . . . 29½ square feet
One duplex boiler feed pump and hot well.
One duplex high pressure Worthington steam pump (1,000,000 gallons), 12″ water plungers and 15″ stroke.
One compound duplex condensing Worthington engine (5,000,000 gallons) 22′ and 22½″ water plungers, and 50″ stroke.
Axis of plungers of large engine at grade.
Suction of large engine, 24″ diameter; Force main, 24″ in diameter.
Suction of small engine, 16″ in well, 12″ at pump; Force main, 12″ in diameter.
Main leading to reservoir, 20″ diameter.

The water is pumped through the mains to the reservoir, making the reservoir a storage and regulating basin.

Bottom of reservoir is grade 247.80
High-water grade 265.80
Capacity . . . . . 15,000,000 gallons
Area at bottom . . . . . 91,525 square feet
Area at high water . . . . . 126,000 square feet
Maximum suction lift for large engine . . . 24 feet
Pump lift for large engine to high water at reservoir . 145–156 feet
Daily average consumption in 1884 . . . 582,804 gallons
Length of mains, Dec. 31, 1884 . . . 69 59-100 miles
Number of services, Dec. 31, 1884 2,919
Number of services in use, Dec. 31, 1884 . . . 2,716
Length of services laid, Dec. 31, 1884 . . . 200,624 feet
Hydrants 433
Meters 878
Cost of construction $966,584.73
Net debt $819,220.33
Gross income for 1884 . . . . . $49,769.01
Greatest pressure on the mains . . . 235 feet head
Works built in 1876.

COMMITTEES.

AMERICAN ASSOCIATION.

Committee of Arrangements.

GEO. A. ELLIS,
City Engineer, Springfield, Mass.

EDWIN DARLING,
Supt., Pawtucket, Mass

Reception Committee.

DESMOND FITZGERALD,
Supt. Western Division Boston Water Works.

EQUITABLE WATER METER CO.,
Boston, Mass.

CHAPMAN VALVE MAN'F'G CO.
Boston and Indian Orchard, Mass.

NEW ENGLAND ASSOCIATION.

Committee of Arrangements.

FRANK E. HALL,
Supt., Quincy, Mass.

J. HENRY BROWN,
Supt., Mystic Div., Boston, Mass.

ALBERT S. GLOVER,
Registrar, Newton, Mass.

ARTHUR H. HOWLAND
Civil Engineer, Boston, Mass.

ALBERT F. NOYES,
City Engineer, Newton, Mass.

WILBUR D. FISKE,
Knowles Steam Pump Co.

JASON GILES,
Chapman Valve Mfg. Co.

CHAS. H. BALDWIN,
Equitable Water Meter Co.

Reception Committee.

R. C. P. COGGESHALL,
Supt., New Bedford, Mass.

L. A. TAYLOR,
Commissioner, Worcester, Mass.

WM. R. BILLINGS,
Supt., Taunton, Mass.

H. G. HOLDEN,
Supt., Lowell, Mass.

W. H. RICHARDS,
Supt., New London, Ct.

EDWIN DARLING,
Supt., Pawtucket R. I.

FALL MEETING.

So. Framingham, Mass.
Sept. 24, 1885.

The regular Fall Meeting of the Association was holden here today, being called to order in Liberty Hall at 9.50 o'clock a. m., President Coggeshall in the chair. In the absence of Secretary Glover, Wm. R. Billings, Superintendent of the Taunton Water Works, was chosen Secretary protempore.

The reading of the Records was waived. A call of the roll showed the following members and guests present:

ACTIVE MEMBERS.

Geo. E. Batchelder,	Registrar,	Worcester, Mass
Wm. R. Billings,	Superintendent,	Taunton, Mass.
Dexter Brackett,	Ass't City Eng'r,	Boston, Mass.
Junius A. Brand,	Superintendent,	Norwich, Conn.
Robert C. P. Coggeshall,	Superintendent,	New Bedford, Mass.
Albert D. Drake,	City Surveyor,	New Bedford, Mass.
Geo. A. Ellis,	Eng'r and Registrar,	Springfield, Mass.
L. Louville Gerry,	Superintendent,	No. Attleboro, Mass.
Frank E. Hall,	Superintendent,	Quincy, Mass.
Jos. C. Hancock,	Superintendent,	Springfield, Mass.
Simpson C. Heald,	Hydraulic Engineer,	Worcester, Mass.
A. H. Howland,	Civil Engineer, U. S. Hotel,	Boston, Mass.
Horatio N. Hyde, jr.,	Superintendent,	Newton, Mass.
A. W. Inman,	Superintendent,	So. Weymouth, Mass.
Moses Joy, jr.,	Pres. and Treas'r,	Milford, Mass.
Willard Kent,	Superintendent,	Woonsocket, R. I.
Wilbur F. Learned,	Resd't Eng'r B. W. W.	Ashland, Mass.
Alfred E. Martin,	Superintendent,	So. Framingham, Mass.

James W. Morse,	Superintendent,	Natick, Mass.
Albert F. Noyes,	City Engineer,	Newton, Mass.
Daniel Russell,	Clerk,	Everett, Mass.
Lucien A. Taylor,	Commissioner,	Worcester, Mass.
Joseph G. Tenney,	Superintendent,	Leominster, Mass.
Chas. K. Walker,	Superintendent,	Manchester, Mass.
M. M. Tidd,	Civil Engineer,	Boston, Mass.
Wm. C. Wilcox,	Clerk,	Watertown, Mass.

ASSOCIATE MEMBERS.

Asbestos Packing Co.,	Boston, Mass.
Chadwick Lead Works,	Boston. Mass.
Randolph Brandt.	New York City, N. Y.
Chapman Valve Co.,	Indian Orchard, Mass.
Knowles Steam Pump Co,,	Boston, Mass.
National Meter Co.,	New York City, N. Y.
Peet Valve Co.,	Boston, Mass.
Union Water Meter Co.,	Worcester, Mass.

GUESTS.

Commissioners Kempton and Howard,	New Bedford, Mass.
John H. Perkins. Superintendent,	Watertown, Mass.
Wm. M. Hawes, Commissioner,	Fall River, Mass.
H. D. Foss, Supt. Streets,	Springfield, Mass.
H. H. Carter, Resd't Eng'r B. W. W.	Framingham, Mass.
Willis M. Ranney, Commissioner,	Framingham, Mass.
Commissioner Fairbanks,	Natick, Mass.

After a short address by President Coggeshall the following applications were considered:

FOR ACTIVE MEMBERSHIP.

Geo. E. Wild, Superintendent, So. Weymouth, Mass.
John H. Perkins, Superintendent, Watertown, Mass.

The Secretary was instructed to cast one ballot for the candidates, which being done, they were declared elected to membership in the Association.

A letter of regret at inability to attend the meeting was read from Peter Milne, Jr., Water Purveyor, Brooklyn, N. Y., President American Water Works Association.

A letter of Albert S. Glover, resigning, on account of ill health, his office as Secretary, was received, read and on motion of Mr. A. H. Howland was laid on the table.

A circular was read from Committee of Civil Engineers Club of Cleveland, Ohio, relating to the matter of employing Civil Engineers in Government work and it was voted to refer the matter to the Executive Committee, said committee to confer with the committee of the Engineers Club of Cleveland.

Mr. A. H. Howland then invited the Association, in behalf of the Framingham Water Supply Company, to participate in a lunch to be served after the excursions. The invitation was accepted and the convention then adjourned.

Immediately after adjournment the Association took barges and proceeded to the Natick Pumping Station where they were received by Commissioner Fairbanks and Superintendent Morse and inspected the new Blake pumps and boilers there being placed under the direction of Mr. Wilbur D. Fiske.

From this point the Association proceeded to Wellesley and through the courtesy of Mr. H. H. Hunnewell, visited his magnificent gardens; thence they drove through the grounds of Wellesley College, by kind permission of the Secretary, Miss Anna M. McCoy, and thence to Bailey's Hotel, passing on the way Waban Valley Bridge of the Sudbury River system of the Boston water supply.

After spending an hour at the Hotel, at dinner, barges were again taken and the Association proceeded to the Basin IV of the Boston Water Works, at Ashland, which was inspected under the direction of Wilbur F. Learned, C. E., Resident Engineer. From here, passing Basin II they drove to Dam I, after an inspection of which the party divided, some leaving the barges and walking over the line

of the Farm Pond Conduit, in process of construction, while others proceeded in the barges through Framingham Centre to the Pumping Station of the Framingham Water Supply Company at South Framingham, there meeting the other members of the Association.

After spending half an hour in inspecting the Pumping Station the Association proceeded to Liberty Hall where, through the courtesy of the Framingham Water Supply Company they found prepared for them a bountiful lunch; this having been satisfactorily considered the Association was called to order and after passing a unanimous vote of thanks to the Framingham Water Supply Co., Commissioner Fairbanks of Natick, Mr. H. H. Hunnewell, and the Trustees of Wellesley College, the Association, at 5.30 o'clock, adjourned.

ALBERT S. GLOVER,
Secretary.

LIST OF SKETCHES FURNISHED AT THE JUNE MEETING

Chronograph	HIRAM NEVONS.
Lever for removing sheeting from back filled trenches	WM. B. SHERMAN.
Water-cart, Hydrant and Tap Cleaner	R. C. P. COGGESHALL.
Stand Pipe and Gate Cover	J. C. HANCOCK.
Gate Box and Service Pipe	W. H. RICHARDS.
Water Cooler for Drinking Fountain	T. C. LOVELL.
Screen and Pump Wells (2 sheets)	A. H. HOWLAND.
Eel Traps	S. E. GRANNIS.
Table of Weights of Lead Pipe	WM. B. SHERMAN.
Fountain Basin Overflow	WM. R. BILLINGS.
Brass Connection for Lead Pipe	H. N. HYDE, JR.
Blue Print Frame	WM. B. SHERMAN.

ERRATA:

Page 31, line 6, for "coal shots" read "cold-shuts."
Page 33, line 11, for "Hudson" read "Edson."
Page 60, line 20, read, "where they tried to prevent a collapse of the boiler," &c.
Page 68, line 13, for "inch-and-a-half tap" read "inch-and-a-half pipe."
Page 73, line 26, for "shaded" read "shallow."
Page 108, line 9, for "kaoline" read "kalamein."
Page 100, line 33, for "he has" read "we have."
Page 112, line 11, for "kaoline" read "kalamein."

MEMBERSHIP ROLL.

January 1, 1886.

ACTIVE MEMBERS.

Babcock, Benj. S.,	Superintendent,	Nashua, N. H.
Bagnell, Richard W.,	Superintendent,	Plymouth, Mass.
Barbour, Wm. S.,	City Engineer,	Cambridge, Mass.
Barney, Wm. H.,	Superintendent,	Milford, Mass.
Batchelder, Geo. E.,	Registrar,	Worcester, Mass.
Battles, Jas. M.,		Lowell, Mass.
Billings, Wm. R.	Superintendent,	Taunton, Mass.
Brackett, Dexter,	Asst. City Engineer,	Boston, Mass.
Brady, Thos. H.,		New Britain, Conn.
Brand, Junius A.,	Superintendent,	Norwich, Conn.
Brinsmade, Dan'l S.,	Civil Engineer,	Birmingham, Conn.
Broatch, J. C.,	Superintendent.	Middletown, Conn.
Brown, J. Henry,	Supt. Mystic Div.,	Boston, Mass.
Caldwell, Jos. H.,	Registrar, Mystic Div.,	Boston, Mass.
Chadbourne, E. J.	Supt. Construction,	Haverhill, Mass.
Chase, John C.,	Superintendent,	Wilmington, N. C.
Clark, Jonas M.,	Superintendent,	Northampton, Mass.
Codd, Wm. F.,	Superintendent,	Nantucket, Mass.
Coggeshall, R. C. P.,	Superintendent,	New Bedford, Mass.
Crehore, Chas. Fred.,	Commissioner,	Newton, Mass.
Cutts, Hiram,	Office of Water Registrar,	Boston, Mass.
Darling, Edwin,	Superintendent,	Pawtucket, R. I.
Davis, H. F.,	Superintendent,	Athol, Mass.
Decker, J. H.,	Superintendent,	Hannibal, Mo.
Dennett, Nathaniel,	Superintendent,	Somerville, Mass.
Dotten, Wm. T.,	Superintendent,	Winchester, Mass.
Drake, Albert B.,	City Surveyor,	New Bedford, Mass.
Ellis, Geo. A.,	Eng. and Registrar,	Springfield, Mass.

Fanning, John T.,	Hydraulic Engineer,	Manchester, N. H.
Fitts, A. B.,	Registrar,	Attleboro', Mass.
Fitzgerald, Desmond,	Supt. West'n Div.,	Boston, Mass.
Forbes, F. F.,	Superintendent,	Brookline, Mass.
Fteley, Alphonse,	Ex. Eng. new aqueduct,	New York, N. Y.
Gardner, L. H.,	Superintendent,	New Orleans, La.
Gerry, L. L.,	Superintendent,	No. Attleboro, Mass.
Glover, Albert S.,	Registrar,	Newton, Mass.
Gow, Robert M.,	Superintendent,	Medford, Mass.
Granniss, Sherman E.,	Superintendent,	New Haven, Conn.
Grush, Benj. S.,	Superintendent,	Salem, Mass.
Haggett, Albert A.,	Ex-Commissioner,	Lowell, Mass.
Hall, Frank E.,	Superintendent,	Quincy, Mass.
Hancock, Jos. C.,	Superintendent,	Springfield, Mass.
Harding, Walter H.,	Registrar,	Cambridge, Mass.
Harris, John,	Commissioner,	Waltham, Mass.
Hathaway, J. H.,	Registrar,	New Bedford, Mass.
Hawkes, Ward W.,	Superintendent,	Malden, Mass.
Heald. Simpson C.,	Hydraulic Engineer,	Worcester, Mass.
Hildreth, Milo,	Registrar,	Northboro', Mass.
Hill, Wm. F.,	Superintendent,	Dedham, Mass.
Hodge, Thos. A.,	Superintendent,	No. Adams, Mass.
Holden, Horace G.,	Superintendent,	Lowell, Mass.
Horan, David W.,	Superintendent,	Clinton, Mass.
Howland, A. H.,	Engineer, U. S. Hotel,	Boston, Mass.
Hull, B. H.,	Civil Engineer,	Bridgeport, Conn.
Hyde, H. N., Jr.,	Superintendent,	Newton, Mass.
Inman, A. W.,	Supt. Construction,	Montgomery, Ala.
Jordon, N. I.,	Treasurer,	Auburn, Me.
Joy, Moses, Jr.,	President,	Milford, Mass.
Kent, Willard,	Superintendent,	Woonsocket, R. I.
Knapp, Horace H.,	Clerk,	Lowell, Mass.
Lane, Addison,	Superintendent,	Melrose, Mass.
Learned, Wilbur F.,	Res. Eng'r B. W. W.,	Ashland, Mass.
Lovell, Thos. C,	Superintendent,	Fitchburg, Mass.
Lyons, Jas. W.,		Lynn, Mass.
Martin, A. E.,	Superintendent,	Framingham, Mass.
Martine, Alfred H.,	Superintendent,	Knoxville, Tenn.
Mason, Marshall,	Superintendent,	St. Albans, Vt.
Miles, Alvoid O.,		Providence, R. I.
Morse, Chas. W.,	Superintendent,	Haverhill, Mass.

Morse, Jas. W.,	Superintendent,	Natick, Mass.
Murdoch, Gilbert,	Superintendent,	St. John's, N. B.
Nevons, Hiram,	Superintendent,	Cambridge, Mass.
Northend, Chas. A.,	Secretary,	New Britain, Conn.
Noyes, Albert F.,	City Engineer,	Newton, Mass.
Parker, F. H.,	Superintendent,	Burlington, Vt.
Perkins, John H.,	Superintendent,	Watertown, Mass.
Pettingill, Amos,	Superintendent	Woburn, Mass.
Porter, James,	Superintendent,	Greenfield, Mass.
Reed, Josiah,	Commissioner,	Weymouth, Mass.
Richards, W. H.,	Superinten lent,	New London, Conn.
Rogers, Henry W.,	Superintendent,	Lawrence, Mass.
Russell, Daniel,	Clerk,	Everett, Mass.
Schleiter, Henry L.,	Superintendent,	Meriden, Conn.
Seymour, Chas. W. S.,	Superintendent,	Hingham, Mass.
Sherman, Wm. B.,	Mechanical Eng'r,	Providence, R. I.
Sprague, Phineas,	Registrar,	Malden, Mass.
Stacy, George A.,	Superintendent,	Marlboro', Mass.
Stanhope, H. R.,	Supt. Construction,	Springfield, Mass.
Taylor, Lucian A.,	Commissioner,	Worcester, Mass.
Tenney, Joseph G.,	Superintendent,	Leominster, Mass.
Tidd, M. M.,	Hydraulic Eng'r,	Boston, Mass.
Walker, Chas. K.,	Superintendent,	Manchester, N. H.
Whidden, Hosea F.,	Commissioner,	So. Abington, Mass.
Whitlock, Frank W.,	Asst. City Eng'r,	Waterbury, Conn.
Wilcox, Wm. C.,	Clerk,	Waltham, Mass.
Wild, George E.,	Superintendent,	So. Weymouth, Mass.
Winship, Horace B.,	Civil Engineer,	Troy, N. Y.
Winslow. Geo. E.,	Superintendent,	Waltham, Mass.
Yates, Richard R.	Superintendent,	Northboro', Mass.

ASSOCIATE MEMBERS.

Asbestos Packing Co.,	169 Congress St., Boston, Mass.
Ashton Valve Co.,	271 Franklin St., Boston, Mass.
Bampton, Robt., Jr., (of Chadwick Lead Works),	171 High St., Boston, Mass.
Blake, Geo. F. Mfg. Co.,	44 Washington St., Boston, Mass.
Boston Lead Mfg. Co.,	162 Congress St., Boston, Mass.
Brandt, Randolph,	38 Cortlandt St., New York, N. Y.

Chapman Valve Co.,	Indian Orchard, Mass.
Cunningham Iron Works,	109 Milk St., Boston, Mass.
Curley, Thomas (of Ward & Curley),	140 Oliver St., Boston, Mass.
Curtis Regulator Co.,	59 Beverly St., Boston, Mass.
Davidson Steam Pump Co.,	77 Liberty St., New York, N. Y.
Deane Steam Pump Co.,	Holyoke, Mass.
Equitable Water Meter Co.,	36 Indian Wharf, Boston, Mass.
Ferguson, Geo. B., (of H. R. Worthington Co.),	145 Broadway, New York, N. Y.
Fiske, Wilbur D., (of Knowles Steam Pump Co.),	44 Washington St , Boston, Mass.
Franklin, Albert B.,	30 Charlestown St., Boston, Mass.
Frost & Adams,	37 Cornhill, Boston, Mass.
Gallison, W. H.,	42 Oliver St., Boston, Mass.
Giles, Jason (of Chapman Valve Co.),	Indian Orchard, Mass.
Gowing, E. H. (of H. R. Worthington Co.),	70 Kilby St., Boston, Mass.
Hartford Meter Co.,	336 Asylum St., Hartford, Ct.
Jarvis Engineering Co.,	61 Oliver St., Boston, Mass.
Jenkins Bros.,	79 Kilby St., Boston, Mass.
Jenks, Henry F.,	Pawtucket, R. I.
Langford, John T.,	70 Kilby St., Boston, Mass.
Ludlow Valve Mfg. Co.,	Troy, N. Y.
Marsh, W. H. (of Tuerk Motor Co.),	12 Cortlandt St., New York, N. Y.
Morton, A. M.,	25 Washington St., Boston, Mass.
Mudge, B. C. (of H. R. Worthington Co.),	70 Kilby St., Boston, Mass.
National Meter Co.,	252 Broadway, New York, N. Y.
National Tube Works Co.,	McKeesport, Pa.
Newman, J. J. & Co.,	19 Wilson St., Providence, R. I.
Pattee & Draper,	Holyoke, Mass.
Peet Valve Co.,	163 Albany St., Boston, Mass.
Phipps, D. Goffe,	New Haven, Conn.
Sampson, Geo. H.,	231 State St., Boston, Mass.
Spooner, D. Brainard,	Sears Building, Boston, Mass.
Sumner & Goodwin,	19 Oliver St., Boston, Mass.
Union Water Meter Co.,	31 Herman St., Worcester, Mass.
Waldo Bros.,	88 Water St., Boston, Mass.
Walworth Mfg. Co.,	16 Oliver St., Boston, Mass.
Ward, W. H. (of Ward & Curley),	140 Oliver St., Boston, Mass.
Wood, R. D. & Co.,	400 Chestnut St., Philadelphia, Pa.
Woodman, Geo. & Co.,	41 Pearl St., Boston, Mass.
Worthington, H. R.,	145 Broadway, N. Y.

INDEX.

(Figures refer to pages.)

Andrew. J. F..... 182
Arnold, Col. O..... 182, 214
Babcock, B. S..... 3, 13, 69, 90, 91, 170
Baldwin, C. H..... 25, 225
Ball, P..... 182
Barney, W. H..... 13, 170
Batchelder, G. E..... 3, 70, 160, 182, 226
Billings, W. R., 3, 13, 32, 39, 47, 50, 51, 65, 66, 69, 85, 88, 95, 96, 118, 137, 140, 150, 153, 160, 165, 182, 225, 226.
Blake, Com'r..... 181
Blake, H. B..... 153
Brackett, D..... 170, 182, 226
Brackett, Speaker..... 181, 206
Brand, J. H..... 97, 98, 101, 226
Brinsmade, D. S..... 13
Broatch, J. C..... 13, 170
Brooks, E. C..... 15
Brown, J. H..... 13, 45, 70, 92, 94, 95, 122, 160, 165, 169, 182
Business, order of,.....9
Caldwell, J. H..... 170, 182
Cate, Com'r..... 15, 153, 181, 219
Caulking..... 95
Chadbourne, J. F..... 106
Chase, J. C., 13, 93, 44, 46, 48, 49, 50, 60, 67, 69, 94, 99, 102, 103, 122, 145, 148, 182.
Clark, E. C..... 181
Clark, J. M..... 182
Codd, W. F..... 170, 182
Coggeshall, R. C. P., 13, 27, 57, 67 68, 69, 103, 118, 144, 151, 153, 160, 166, 169, 182, 225, 226, 227.
Committees..... 225
Constitution and By-Laws..... 5

Convention Fourth Annual..... 11
Corcoran, Com'r..... 181
Crehore, Com'r..... 170
Croes, J. F. R..... 122, 182
Cutts, H..... 15, 182
Darling, Com'r..... 181
Darling, E..... 3, 13, 21, 28, 31, 37, 43, 70, 91, 160, 165, 168, 169, 182, 225
Davis, H. F..... 170
Decker, J. H..... 15, 182
Dennett, N..... 122, 182
Discharge through hose..... 152
Doyle, Mayor..... 181
Drake, A. B..... 13, 170, 182, 226
Eaton, H. L..... 181
Election of officers..... 69
Ellis, G. A., 3, 11, 13, 17, 27, 36, 47, 48, 56, 67, 69, 70, 88, 92, 94, 95, 102, 103, 104, 106, 122, 140, 144, 145, 146, 147, 149, 150, 151, 153, 160, 162, 169, 170, 171, 173, 185, 195, 198, 201, 202, 205, 209, 211, 212, 214, 219, 225, 226.
Fanning, J. T..... 170
Faxon, Com'r..... 181
Fiske, W. D..... 25, 225
Fitzgerald, D..... 170, 213, 225
Forbes, F. F..... 161
Foss, Com'r..... 181
Fteley, A..... 15
Gardner, Pres't..... 15, 171, 172, 188
Gerhard, C. F..... 122
Gerry, L. L..... 161, 182, 226
Giles, Jason..... 25, 225
Gow, R. M..... 14, 113, 160, 182
Grannis, S. E..... 3, 14
Haggett, A. A..... 170, 181, 219
Hall, F. E., 3, 11, 14, 25, 27, 28, 69, 70, 79, 95, 107, 160, 165, 166, 168, 169 182, 225, 226.
Hancock, J. C..... 14, 71, 182, 226
Harding, W. H..... 3, 70, 161
Harris, Com'r..... 15, 181
Hathaway, J. H..... 14, 141, 147, 160, 169
Heald, S. C..... 14, 64, 66, 67, 170, 226
Hildreth, M..... 15
Hill, W. F..... 160

Hobbs, Com'r 181
Hodge, T. A. 14
Holden, H. G., 14, 39, 73, 76, 77, 78, 79, 80, 89, 90, 93, 96, 98, 100, 104, 122, 160, 169, 225.
Horan, D. W., 14, 16, 27, 69, 80, 84, 89, 93, 96, 97, 122, 160, 161, 165, 169.
Howland, A. H., 14, 25, 28, 48, 77, 78, 79, 83, 84, 91, 92, 93, 95, 96, 102, 104, 105, 146, 147, 160, 165, 168, 169, 225, 226, 228.
Hull, B. H. 14, 170
Hyde, H. N., Jr. 14, 80, 90, 91, 92, 93, 94, 95, 102. 103, 104, 122, 160, 226
Hyde, Hon. H. S. 153
Inman, A. W. 14, 170, 226
Jerricks, A. H. 48, 50
Joints, ... 94
Jordan, N. I., ... 3, 70, 160, 169, 181
Joy, M., Jr., 14, 29, 39, 41, 47, 49, 50, 51, 66, 95, 96, 98, 101, 102, 145, 148 226.
Kent, W., ... 14, 170, 226
Kimball, Mayor, ... 181
Kingsley, Com'r, ... 181
Knapp, H. H., ... 14
Lane, A., ... 14
Learned, W. F., ... 81, 170. 226. 228
Leshure, A. P., ... 152
Long, Pres't, ... 153
Lovell, T. C., ... 14, 31
Mains, flushing of, ... 70
Manley, H., ... 181
Meeting, Springfield, ... 11
Meeting, Special, ... 160
Meeting, Boston, ... 170
Meeting, Framingham, ... 226
Milne, Peter, ... 182, 201, 227
Miscellaneous Subjects, ... 92
Morse, C. W., ... 160, 165
Morse, J. W., ... 14, 227, 228
Moulton, Commissioner, ... 181
Nevons, H., ... 14, 100, 101, 104, 105, 160, 168
Noyes, A. F., 14, 16, 25, 27, 28, 34, 42, 44, 48, 62, 76, 77, 87, 88, 94, 144, 147, 148, 154, 160, 169, 225, 227.
O'Brien, Mayor, ... 172, 199
Officers, Election of, ... 69
Officers, List of, ... 3

Packing, ... 92
Parker, F. H., ... 3, 14
Perkins, J. H., ... 227
Pettingill, A., ... 161
Phillips, Mayor, ... 12
Pipe, Weights of, ... 28, 154
Price, J. F., ... 122
Pulsifer, Hon. R. M., ... 181
Reed, J., ... 15, 106
Report, Executive Committee, ... 15, 161, 171
Report, Entertainment Committee, ... 25
Report, Model of, ... 127
Report, Uniformity in, ... 118
Report of Secretary, ... 22
Report of Treasurer, ... 22
Rice, L. F., ... 181
Richards, W. H., ... 3, 14
Robinson, Gov., ... 195
Rogers, H. W., ... 122, 160
Roll Call, ... 13, 160, 226
Rotch, Mayor, ... 107, 181
Russell, D., ... 14, 68, 69, 227
Safford, J. D., ... 153
Sanderson, Chairman, ... 11, 153
Sanitary Engineer, ... 122
Schleiter, H. L., ... 14, 73, 92, 93, 122
Service Pipe, ... 89
Seymour, C. W. S., ... 14, 170
Simmons, Commissioner, ... 181, 202
Smith, Commissioner, ... 181
Sprague, P., ... 160
Stacy, G. A., ... 14, 36, 94, 99, 170
Stanhope, H. R., ... 15, 103
Statistics of Public Works, ... 221, 222, 223, 224
Stebbins, Hon. S. B., ... 181
Street-mains, Flushing of, ... 70
Street-mains, Kinds in Use, ... 107
Swaine, Prof., ... 181
Tanks, Necessity of, ... 51
Taylor, L. A., ... 14, 27, 40, 107, 122, 160, 169, 225, 227
Tenney, J. G., ... 227
Tidd, M. M., ... 15, 227

Topics for Discussion, ...428, 51, 70, 92, 107, 118, 154
Vose, Prof., ...181, 219
Wadleigh, Commissioner, ...181
Walker, C. K., ...122, 227
Walker, J. H., ...15, 45
Water Works Reports, ...118
Welch, A., ...15
Wells, Senator, ...181, 211
Whidden, H. F., ...170
Whipple, Hon. W W., ...181
Whitney, Chairman. 181
Whitlock, F. W., ...15
Wilcox, W. C., ...14, 122, 141, 160, 169, 227
Wild, G. E., ...227
Wilder, Commissioner, ...181
Winship, H. B., ...14
Winslow, G. E., ...15
Wyman, Col. J. T., ...182
Yates, R. R., ...15

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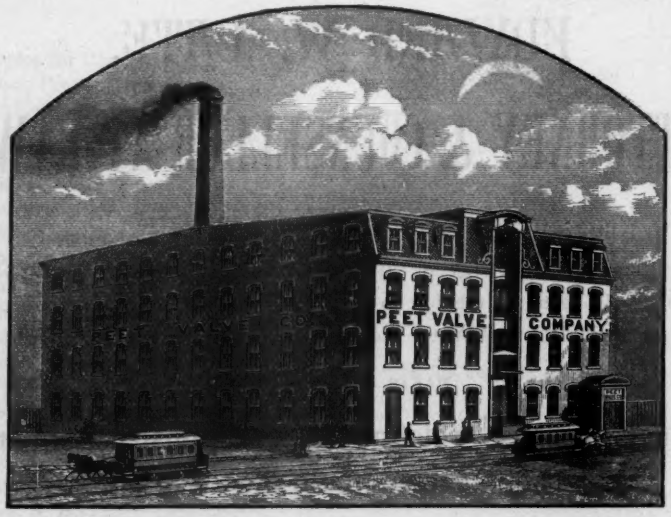

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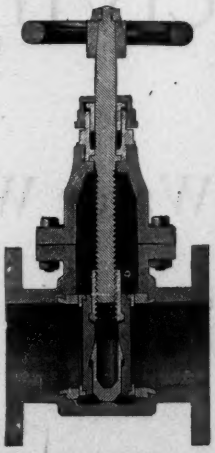

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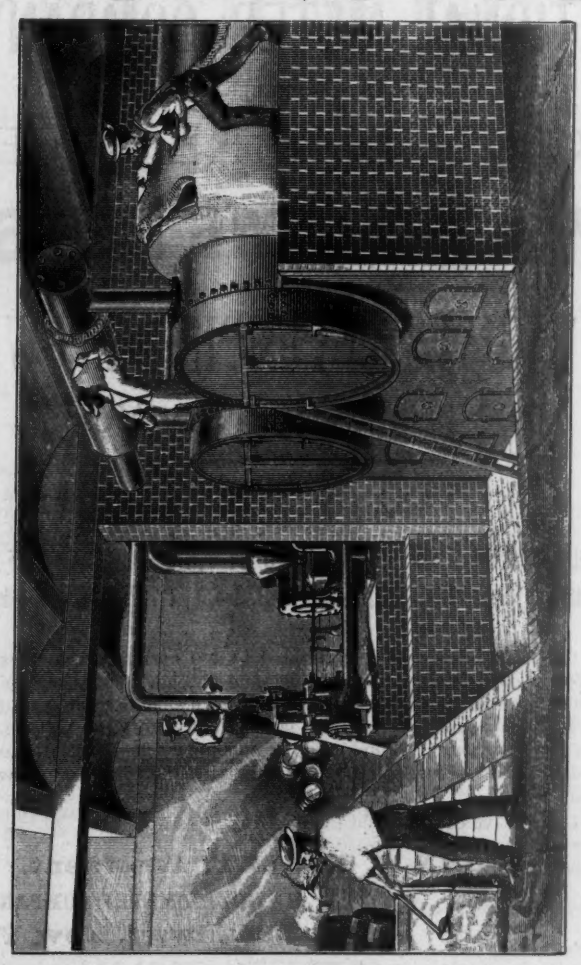

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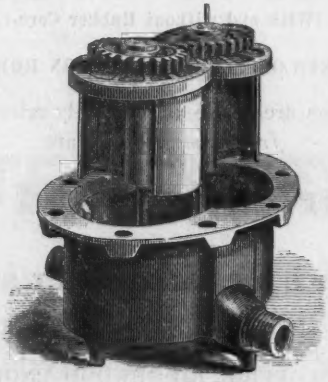

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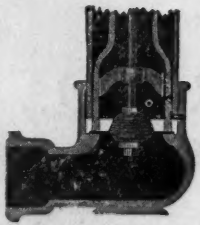

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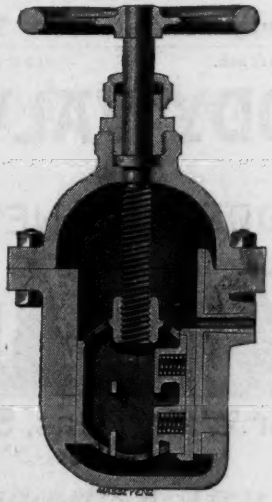

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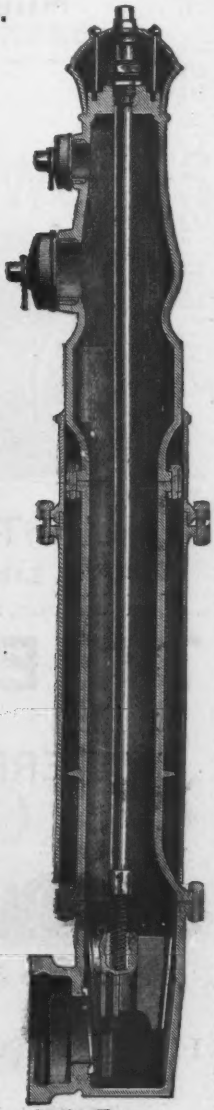

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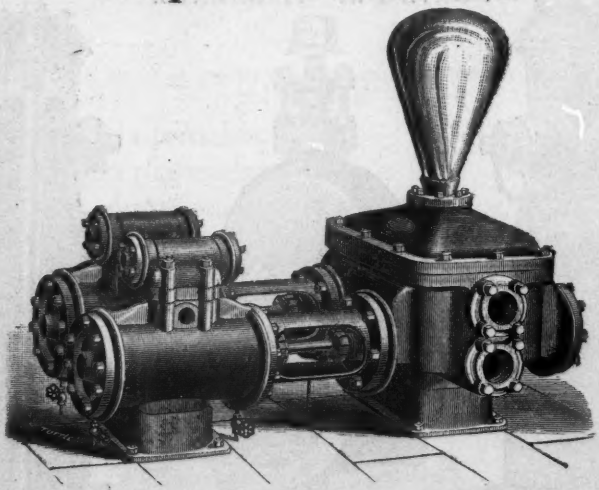

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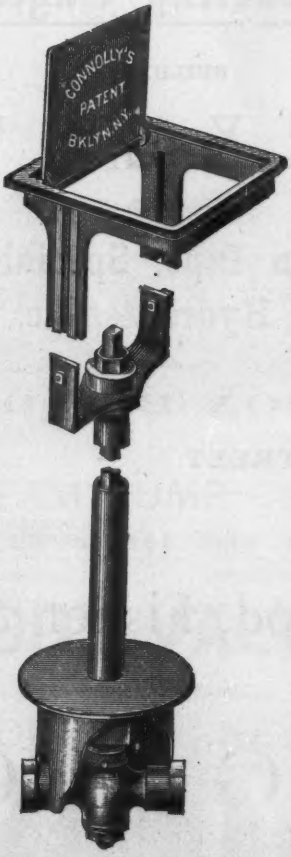

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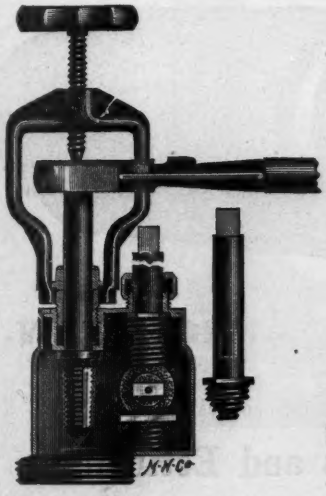

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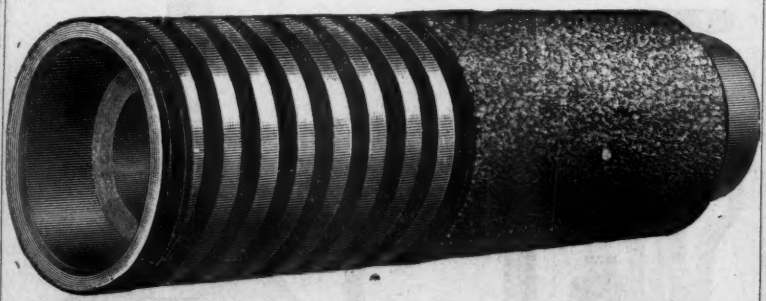

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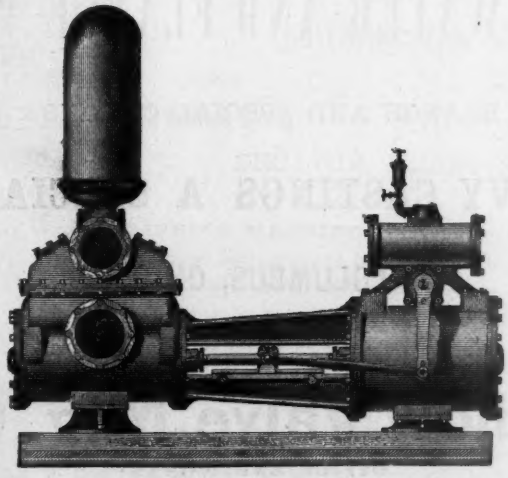

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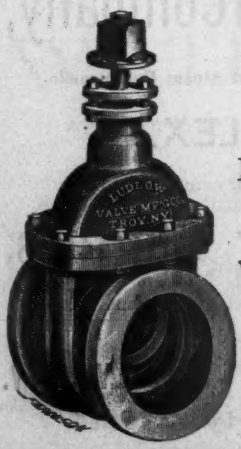

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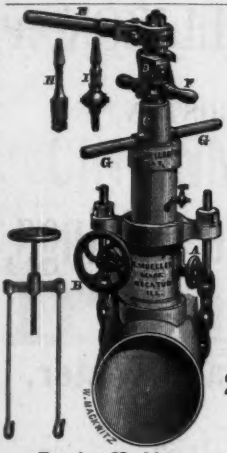

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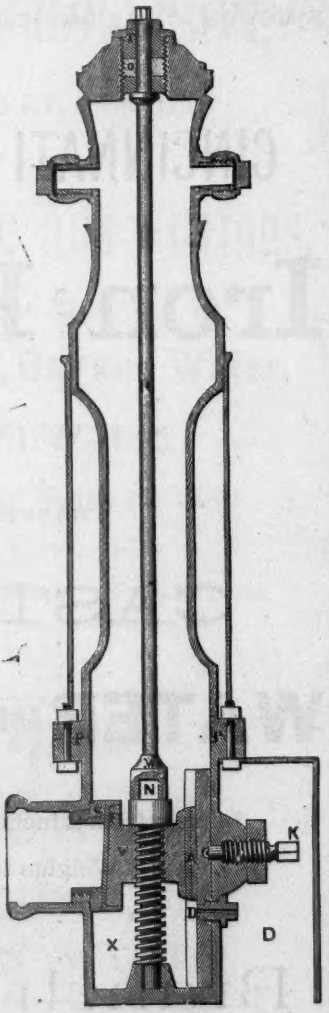

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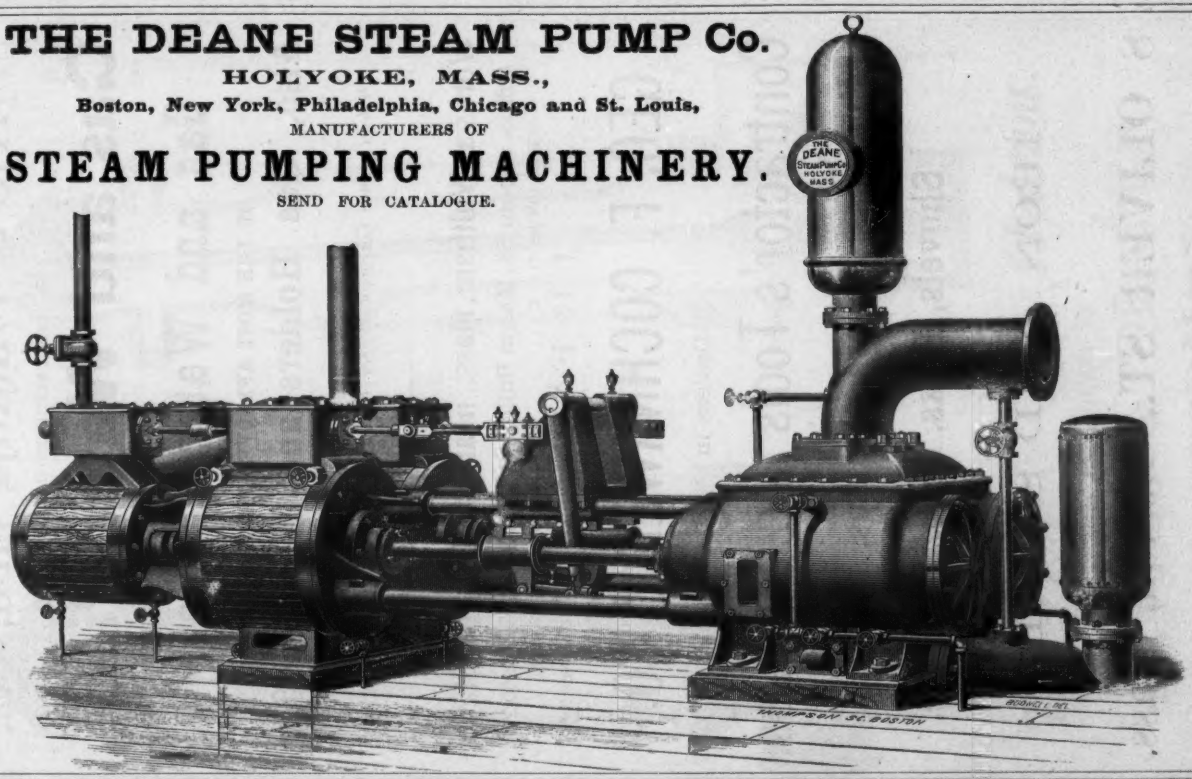

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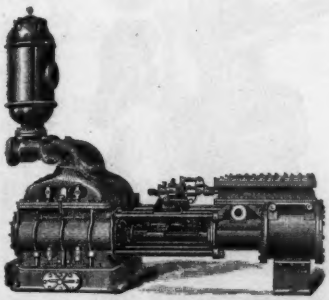

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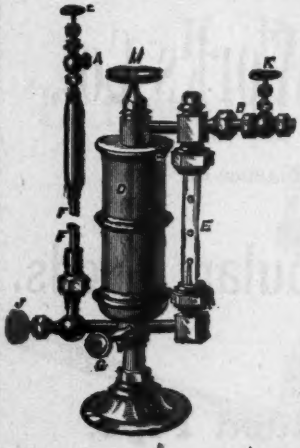

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No. 3.

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On the base is placed a column with a door or movable panel in one side, through which the supply and gas pipes are reached, to make connections, etc. This column supports a larger or upper basin (which is three feet five inches in diameter, twelve inches deep and holds forty gallons), at a height of four feet three inches above street grade, or at sufficient height for horses to drink with ease, without the driver being obliged to uncheck them.

At the top and in the centre of this basin is an ornamented post which supports a lantern at the same height as the ordinary street lantern. At the base of the post four mythical aquatic figures are attached, and from the mouths of these the water flows into the larger basin. The waste water supplies the dog trough below. On account of the form and construction of the Fountain, poles and shafts of wagons, etc., pass underneath the large basin, allowing the horse to stand in a natural position while drinking. Water runs all winter without freezing.

It may be located in the centre of a square or street, or close to the sidewalk. Drinking cups may be attached. The whole design of the Fountain is symmetrical, and it is an ornament to any locality.

These fountains are in use in various parts of the country, and always give perfect satisfaction.

DESCRIPTION, NO. 3.

No. 3 fountain is not intended for the use of horses. It is usually located on the edge of the sidewalk for the convenience of men, women and children, and furnished with self-closing faucets, or may be arranged for continuous running water and furnished as shown in engraving, or the top may be extended to attach a lantern.

When used as a cold-water fountain, the ice-box is placed underneath, near the base of the fountain, with double covers to preserve the ice.

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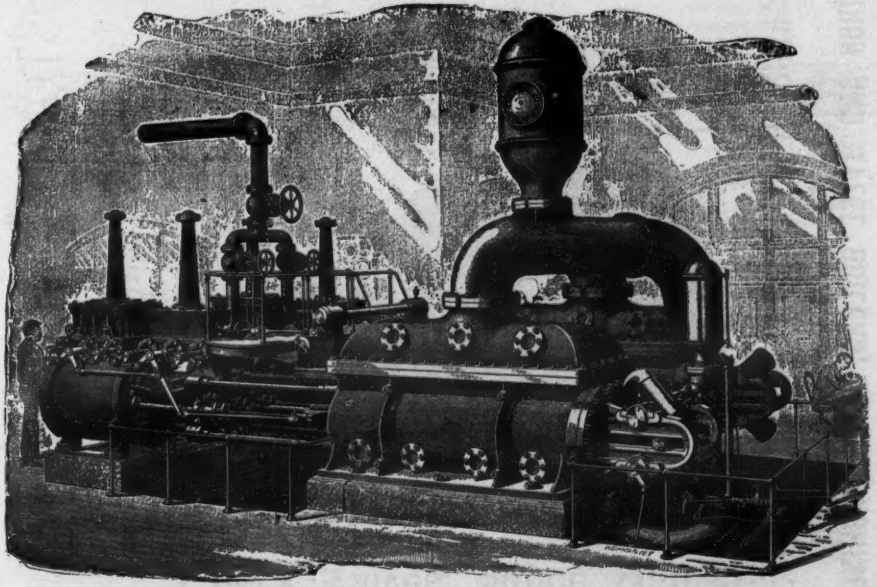

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do	do	½	do	do	do	for Iron Pipe,	2lbs. 2oz.
do	do	¾	do	do	do	do	2lbs. 6oz.
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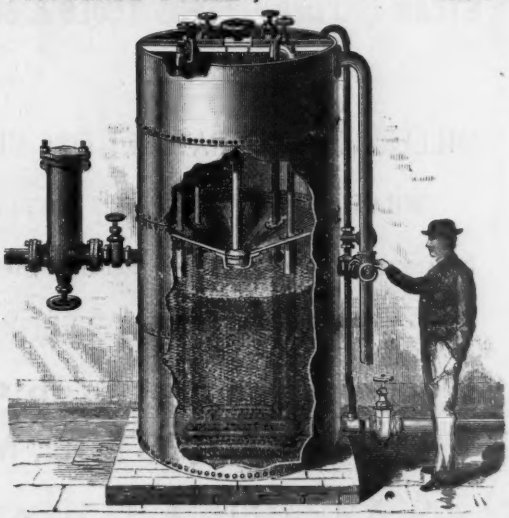

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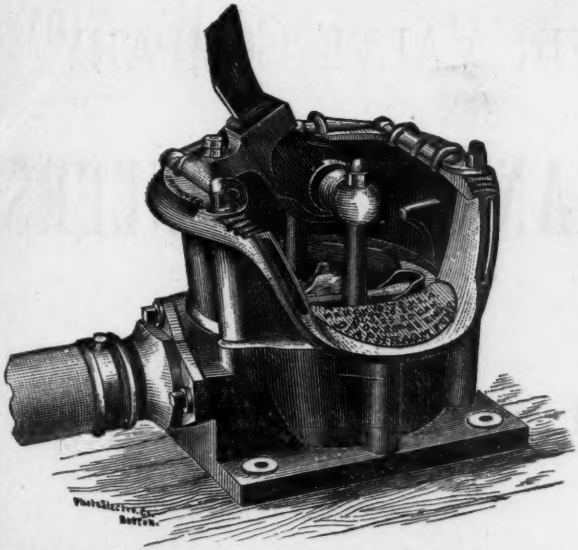

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